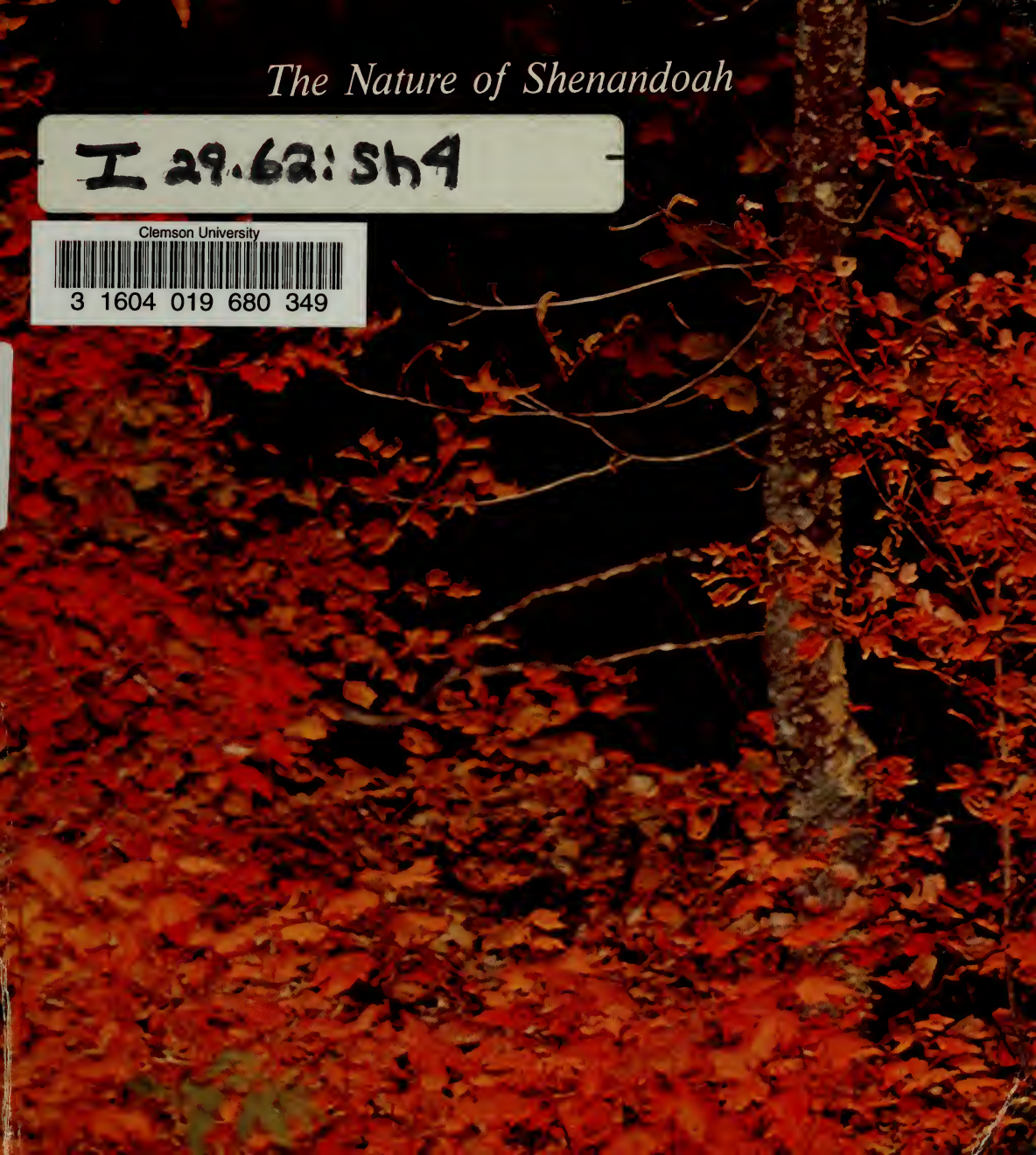

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The Nature of Shenandoah

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A Naturalist's Story
of a Mountain Park

by
Napier Shelton

1975
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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

National Park Service
U.S. DEPARTMENT OF THE INTERIOR

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Preface

This book is a natural history of Shenandoah National Park. It tells the story of plants, animals and men living on this particular piece of earth, not only as it exists now, but also as it has existed in the past. The geologic records show us that over the long term nature has wrought the most profound changes. Yet over the short term we and our ancestors have also shaped this landscape, for good and ill, and its future rests to an important degree in our hands.

Though the book is not intended as a guide to the park, it does indicate some of the places to see aspects of the park's story —such as deer, different kinds of forest, and geologic evidence of past events. It is designed for an evening's reading, most profitably just before or during a visit to the park. Checklists are included in the appendix for persons with special interest in particular groups of plants or animals.

My first-hand knowledge of Shenandoah was gained over a number of years and sharpened in two months of intensive research. Literature and other persons supplied much of the information on which this book is built. Some of the most helpful literary sources are listed in the appendix. The persons who have contributed in some way are legion, but I would like to single out a few for special thanks.

The park staff, including seasonal naturalists, supplied much information and simplified the logistics of field research. I should like to extend particular thanks to former Superintendent Taylor Hoskins, Chief Naturalist E. Ray Schaffner, former Assistant Chief Naturalist Bruce McHenry, Naturalist Frank Deckert, Chief Ranger Douglas Warnock, District Ranger Robert Johnson, Ranger Roy Sullivan, and Fire Control Aide Clinton Runyon.

Two "civilians" were exceptionally helpful. Darwin Lambert, a writer who lives a pioneer life on the edge of the park and who has known the Blue Ridge since pre-park days, answered many questions and allowed me to use information from his new book about man/nature relationships in Shenandoah. My chapters about Indians and mountain farmers are based to a large extent on his manuscript, though he is of course not responsible for my interpretations. Charles E. Stevens of Charlottesville, Virginia, enthusiastically imparted some of his detailed

store of knowledge about the park's geology, plants, and birds on field trips in the south section. He also developed the habitat classification and provided much of the information that appears in checklists in the appendix.

The Big Meadows people—Hugh and Aggie Crandall, Henry and Millie Heatwole—generously shared their intimate knowledge of the park and offered warm hospitality. Such people are the best friends a park or a park researcher could have. Virginia Phelps made a special effort to obtain needed photographs.

For reviewing the geology chapter or supplying geological information, I would also like to thank Drs. John C. Reed, Jr., Frank C. Whitmore, Avery Drake, and John T. Hack, all of the U.S. Geological Survey. Allen Patterson and Mrs. Zada Lam, former residents of the park area, supplied useful details about the past. William Witt reviewed the chapter, Biography of a Stream, and made the checklist of reptiles and amphibians; Dr. Robert Jaeger provided other herpetological information. Peter Mazzeo, Curator of the herbarium at the National Arboretum, kindly reviewed chapters 4 through 7 and the plant checklists. Drs. Oliver Flint (insects), Richard Manville (mammals), and Alexander Wetmore (birds) helped in their areas of special knowledge.

I hope I have made accurate and interesting use of the information so abundantly proffered.

Napier Shelton
Washington, D.C.
March, 1975

The Raven and the Bear

High above the rocky brow of Stony Man Mountain, a raven glides, contemplating his world. It is a world of height and depth and distance, where slopes fall far below to soundless streams, and ridge follows ridge to a blue horizon. It is a world of sun, wind, clouds, rain, and snow, where the full benevolence and fury of nature are felt. And wherever he looks down, the raven sees the forest that mantles the mountains with a seamless green robe.

Beneath that leafy mantle, a bear ambles slowly along a stream, pausing now and then to sniff the air or turn a rock. His world is hidden, muted, secret, a place of ferns, moisture, growth and decay, where a million living things eat, are eaten, mate, die—quietly, almost invisibly. The force of sun, wind, and rain are damped by the green roof of this forest home, making beneath it a moderate place where living is a little easier.

As visitors to Shenandoah, we can enjoy both worlds. Along Skyline Drive and high foot trails, we can rejoice with the raven over the sweep and majesty of these mountains. Following paths down into the hollows, we can discover the quiet beauty and richness of the bear's world.

What makes the difference in these worlds—these extremes in mountain environments? The conditions of life in Shenandoah, as elsewhere, are created by elements of weather acting upon the earth's skeleton of rock and flesh of soil. In summer, the "livin' " is easy. The sun shines long enough and directly enough, and rain comes often enough, to allow green plants to grow in abundance and manufacture the food upon which all animals ultimately depend. But within this general adequacy there is much variation, caused by the whims of weather and the shape of the land. Spend a night on Hawksbill, highest mountain in the park, and you will appreciate the warmth of your sleeping bag. But take an afternoon walk along the western slopes and ridges and you will equally appreciate the water in your canteen, for here the sun bakes the earth, sucking moisture relentlessly from the soil. For relief, you can descend to a deep hollow, where the slopes cut off much of the sunlight and allow a wetter, cooler environment.

In winter, the sun shines for a shorter time and more obliquely, and the wind whips the leafless slopes, creating coldness that most

life must escape through dormancy or migration. We can enjoy this cruel, though sometimes beautiful, season only by wrapping ourselves in our manmade cocoons. Again, the hollows moderate the impact of the elements, and you will find more life here than on the ridges.

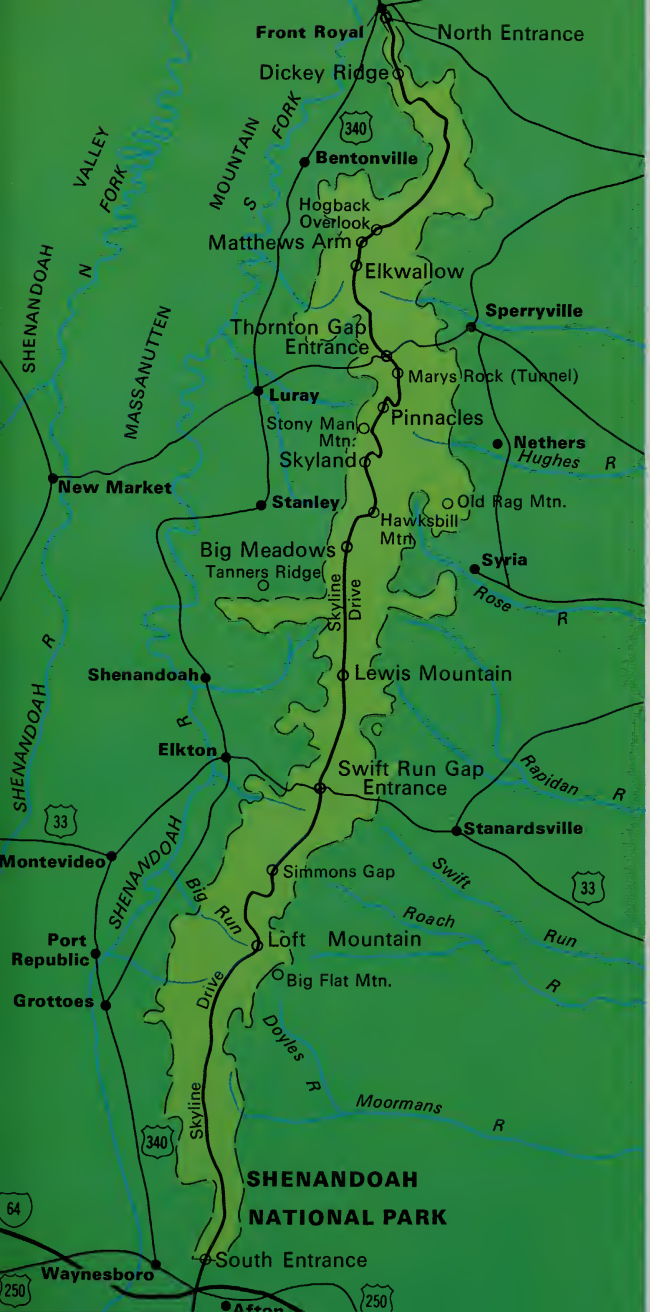
At all seasons, the heights receive more rain and snow than the hollows, since moisture condenses as it rises and cools. Often, this condensation envelops the ridges with clouds so thick you can scarcely see to drive through them, but sometimes cooler air in the lowlands reverses conditions, and the peaks emerge like islands from an ocean of cottony fog.

Variation in natural forces and mountain topography produces corresponding variety in that seemingly uniform forest that covers the Blue Ridge. From the giant hemlocks and yellow-poplars (tulip trees) along lower watercourses to the stunted oaks or drought-defying pines on ridgetops, Shenandoah's forests change with conditions. Within the forests, animal life reflects the variations in its home. Coursing down through the forests and leaping over greenstone ledges, streams make another sort of home. And wherever openings in the forest have been created, still different plant and animal life is found.

The variety we can discover in Shenandoah is enhanced if we consider time as well as space. For over centuries and millenia, climatic change, movements in the earth's crust, and more recently the hand of man have wrought immense changes in the appearance of the land and the forms of life that can survive here. In our minds we can see a procession of life—dinosaurs feeding among tree ferns, mastodons wandering below spruce-covered ridges, Indians setting fires to corral game, mountain folk hoeing hillside patches of corn. Much of white man's influence we can still read in the character of the forests. And change, as always, continues.

The free play of natural forces, making communities of plants and animals suited to their environments, can be seen and appreciated in all national parks. But Shenandoah, like the others, has its own special values. One is the story it tells us about men who lived here, about their successes and failures in living with the land. Another is an accident of geography—its nearness to the eastern urban swarm. In an hour and a half, people can drive from the crowds of Washington to the deep solitude of Shenandoah forests or the fresh heights along Skyline Drive. A few hours more can bring people from most of the east.

What fortune to have the worlds of raven and bear at the doorstep of Megalopolis!


Front Royal
North Entrance
Dickey Ridge
340
Bentonville
Hogback Overlook
Matthews Arm
Elkwallow
Sperryville
Thornton Gap Entrance
Marys Rock (Tunnel)
Luray
Stony Man Mtn.
Pinnacles
Nethers
Hughes R
Skyland
New Market
Stanley
Old Rag Mtn.
Hawksbill Mtn.
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Moormans R
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SHENANDOAH NATIONAL PARK
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VALLEY
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MASSANUTTEN

The Last Billion Years

From Hogback Overlook, highest in the north section of the park, you can see to the heart of the Appalachians. As your gaze travels westward, it first falls on the South Fork of the Shenandoah River, winding far below in its valley. Beyond, the two ridges of the Massanutten Mountains rise, hiding the Shenandoah's North Fork on their far side. Still farther westward, two or three ridges of the main Appalachian body fade away into the blue haze of West Virginia. This soul-lifting scene has the look of eternity about it, giving a feeling of peace and stability. But from an earth-time point of view, even these mountains illustrate that change is the norm, for the main features of the view from Hogback probably have existed for less than one-twentieth of earth's history.

To learn what happened here before the Blue Ridge and its westward companions were formed, we must look at the rocks. Just south of Thornton Gap, at Marys Rock Tunnel, Skyline Drive goes through granodiorite at least 1.1 billion years old. This is part of the ancient granitic rock which forms the core of the Blue Ridge. Though exposed now, this rock was formed miles below the surface under tremendous heat and pressure.

The earliest landscape that can be reconstructed from present geologic evidence was carved in these granitic rocks after their overburden was eroded away. Wind and rain sculptured them into an irregular pattern of hills and valleys, the hills rising as much as a thousand feet. It was a bleak scene, lifeless except possibly for a few algae clinging to the rocks.

This scene was dramatically transformed some 800 million years ago by a series of lava flows, which poured out of long cracks, or fissures, in the granite and gradually filled the valleys. (Greenstone dikes in the older rock at Marys Rock Tunnel and on Old Rag represent two of these fissures.) Eventually even the hilltops were buried under these fiery flows, producing a broad plateau in place of the former hilly landscape. How deep this lava was we can only conjecture, for its upper layers have been eroded from the Blue Ridge. In the Big Meadows-Stony Man area 12 flows, with a total thickness of 1800 feet, have been detected. The accumulated lava flows may originally have been several times as thick.

Today, remnants of these lava flows form many of the cliffs in the park, most notably Franklin Cliffs near Big Meadows and the cliffs on the west side of Stony Man. Most of the park's waterfalls occur where streams plunge over ledges of this rock. (The new mineral composition of the rock gives it a distinctive green color, hence its name—greenstone.) The original volcanic nature of the rock is not now obvious because it was changed subsequently by heat and pressure due to burial deep within the earth; but traces of the gas bubbles that formed in the hot lava, and vertical columnar joints that formed when the lava cooled and cracked can still be seen.

The crust of the earth is more flexible than we might imagine, and when subjected to pressure it moves. After a long existence, the plateau was subjected to some great force which slowly depressed it beneath a rising sea. And perhaps it was those same pressures that formed the mountains, now gone, which rose along the eastern edge of our continent. Whatever the causes, the present Appalachian area became a long trough filled by an arm of the ocean. Into this shallow trough washed sediments from the

uplands. For many millions of years, long enough for life to evolve from simple soft-bodied sea animals to bony fish and finally to the great experiment of land-dwelling amphibians, the deposition went on. Though the shorelines of the sea fluctuated, the long-term trend was toward shrinkage, so that much of the eroded material never reached the sea but was deposited in streambeds and over the land by floods. In the later stages of the Appalachian trough, we can imagine a rather level, perhaps swampy area lying west of the present Blue Ridge. Ferns and canelike horsetails spring from the ground. Here and there strange, scaly trees rise above them. Near pools presided over by giant dragonflies, descendants of lobe-finned fishes drag themselves through the vegetation.

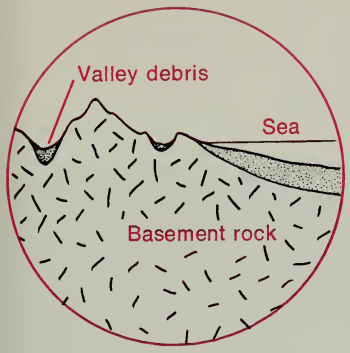
Although some 30,000 feet of sediments were deposited in that great depression during the 350 million years of the Paleozoic Era, only the lowest (oldest) part of it remains today on the Blue Ridge. These sedimentary remnants consist of white, gray, or purple quartzites (made from sandstone) and interbedded shales (made from mud), which are exposed chiefly in the south and north sections of the park. The only evidence of life preserved in these rocks is the long, tubelike structures called *Scolithus,* presumed to be the burrows of worms that tunneled into the sandy sea floor long before it was compressed into rock.

The great swamps of the Appalachian trough, in which were entombed the plants that we mine as coal, were destined to be erased forever by that profound geologic event known as the Appalachian Revolution. Some 200 million years ago, pressures from the southeast gradually folded and sometimes buckled those thousands of feet of sediment, forming the Appalachian Mountains. Depending on the rates of uplift and erosion, these mountains in their early days may have looked like the Alps or may have appeared much as they do today.

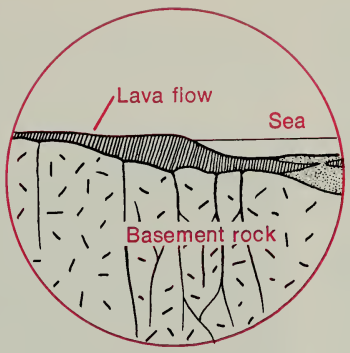
Geology of the Blue Ridge

Take a 50-million-year step now, to the period called the Jurassic, and what do we see? The west slopes of our ancestral Blue Ridge face other peaks; but eastward the mountains diminish to a lowland along the coast. Encouraged by a warm climate (the norm for most of earth's history), ferns, palmlike cycads, and conifers not greatly different from our present ones dot the landscape. A carnivorous dinosaur, running on its big hind legs, emerges from the trees in pursuit of one of its lesser brethren. Insects make their shrill music. To us it is still an alien scene.

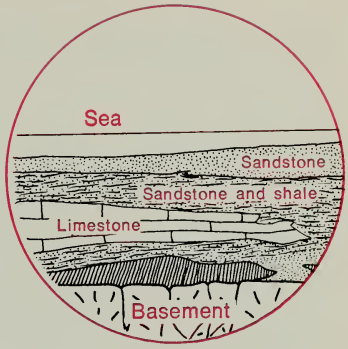
Jump another 125 million years, to the Miocene, and we feel more



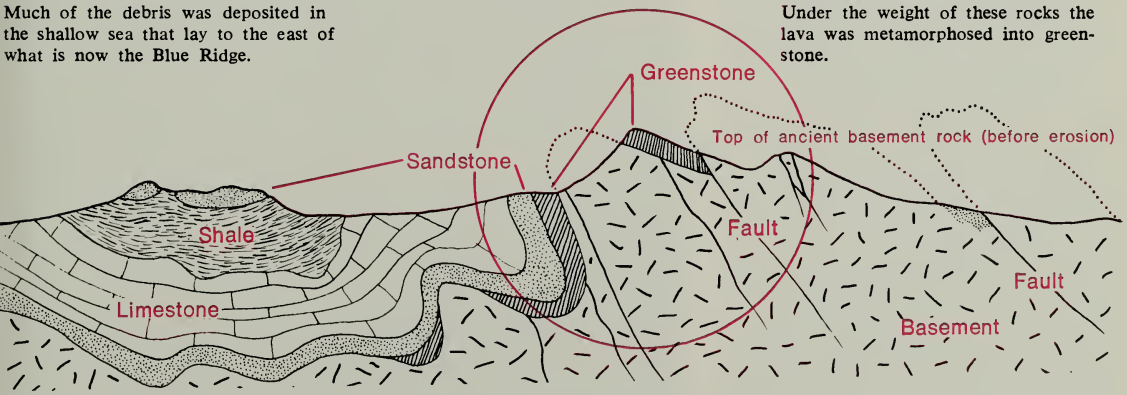
The oldest exposed rocks in the Blue Ridge are granites and gneisses more than a billion years old. Long after these were formed deep within the earth, they were uplifted and laid bare by erosion. Further erosion carved deep into these "basement rocks". Much of the debris was deposited in the shallow sea that lay to the east of what is now the Blue Ridge.



Much later, molten basalt welled up through cracks in the basement rock and flowed across the landscape. By the time this volcanic outpouring ceased, it had created a vast, featureless lava plain.



About 600 million years ago the lava plain was downwarped and covered by a shallow sea. As it continued to subside, sediment accumulated on the bottom of the sea, eventually resulting in shales, limestones, sandstones, and conglomerates 30,000 feet thick. Under the weight of these rocks the lava was metamorphosed into greenstone.



About 230 million years ago the mountain building and uplift reached a climax as the sedimentary rocks were buckled into huge folds and were lifted above sea level. Erosion attacked the softer limestone and shale, leaving a series of long, parallel ridges of sandstone and conglomerate; these rocks were eventually eroded away, exposing the greenstone and basement rocks. The Blue Ridge is the core of one of these ridges.

at home. The mountains now have a cover of forest trees very much like our present ones. Walking the Blue Ridge slopes, we find maples, oaks, ashes, hickories, chestnuts, beeches, and walnuts—not the same species as today, but quite recognizable. At our approach, a three-toed horse quits its browsing to run, and a large bearlike dog slinks into the forest. The rise of mammals has followed the development of deciduous trees, which in turn has followed a cooling trend—a trend that will reach a climax in the Pleistocene, or ice age.

Just a tick on the geologic clock before the present, the ice age presents a Blue Ridge scene that is both familiar and unfamiliar. Scanning the ridge at the climax of the last major glaciation, about 15,000 or 20,000 years ago, we recognize the individual peaks by their contours; but the forest and its life surprise us. The edge of the massive glacier is some 200 miles north of us and the cool climate that accompanies it has mantled the highest slopes with spruce and fir. As we sit under the dark conifers crowning Stony Man, gray jays mew furtively in the boughs overhead, and a porcupine ambles from one tree base to another. Along a trail made by white-tailed deer and black bears, a cottontail rabbit hops toward us. Now we look far down the ridge and see a pack of dire wolves crossing a saddle. Descending into a hollow, they suddenly bolt as a great gray mastodon emerges from the forest. This sight climaxes a day in which we have seen some animals that today are extinct (dire wolf and mastodon), some that now are only found farther north (gray jay and porcupine), and some that still live in the Blue Ridge. The ranges of these animals remind us that Shenandoah climates of today are only a few degrees removed from those of the Pleistocene, and that another ice age could easily return.

During that immense interval between the rise of the Appalachians and the present, the infinitely slow but persistent forces of erosion have worn down the ranges to low, rounded ridges of resistant rock, and rivers such as the Shenandoah have carved deep valleys in the softer limestone and shale. These forces—wind, water, freezing, thawing, and gravity—continue their work today. Masses of gray boulders, lying still in steep ravines, may move again in the next big rainstorm. Ice collecting in a crack may chip another piece off the face of Stony Man. And every day, streams carry bushels of soil down the steep slopes.

Though the view from Hogback does not directly tell us, nature creates, and nature destroys.

Big Meadows was an important hunting ground for the Indians.

"If I were an Indian, I'd sit under this oak tree waiting for game." Assistant Chief Naturalist Bruce McHenry got nods of agreement from the group of visitors he had led out along the quartzite backbone of Rocky Mountain. Along the way, he had told them how Indians once used these ridges as sources of stone for weapon points and, no doubt, as lookouts. Now, having absorbed the view from a projecting outcrop and having tried to imagine themselves Indians, the hikers were filing back toward Skyline Drive. The naturalist had hardly made his comment about sitting under the oak tree when he suddenly stopped, bent down, and with a triumphant smile picked up a perfect quartz arrowhead. In one instant the yesteryear he had been trying to evoke became real. The walk was "made." That night at the campfire program they were still talking about it. One man teased McHenry: "You really planted it there, didn't you?"

Such finds are not unusual. Around Big Meadows, on Lewis Mountain and Tanner's Ridge, at Hawksbill and Pinefield Gaps, and in many other places, arrowheads, spear points, stone knives and

other clues confirm the long use of the Blue Ridge by Indians. The nature of these tools further tells us that the Blue Ridge was primarily a hunting ground, rather than a place of settlement. Aside from one fragment of a pot (indicating food or water storage) found in a rock shelter on Madison Run, and some burial mounds (suggesting the site of a village) found near Jarman Gap, there is no evidence that Indians established other than temporary hunting camps in these mountains. And this use of the land is not surprising. It was only natural that the Indians should choose the lowlands, with both fertile soil and an equable climate, for settlement.

The tide of man's migration into North America (apparently by way of the Bering land bridge) reached the Shenandoah area at least 10,000 and perhaps 13,000 years ago. For the first 9,000 or more years of their existence here, the Indians were hunters and gatherers, moving to wherever they could find food. About 3,000 years ago, they learned how to make clay pottery. Then, about 1,000 years ago, the revolutionary discovery, made by tribes in Mexico, that food plants could be domesticated and raised at chosen places finally reached the Indians of Shenandoah. At about the same time, they learned the use of bow and arrow. After these culture-shaking introductions, hunting, fishing, and gathering of wild foods gradually became supplementary activities carried on from their villages near fields of corn, squash, gourds, and beans.

The Valley and Piedmont scene in late Indian days, as reported by early explorers, was a patchwork of fields and forests, perhaps not greatly different from today's pattern. The open places were gardens, some dotted with the stubs of girdled and burned trees, and grassy expanses made by Indian fires and perhaps by the filling in of beaver ponds. Herds of elk and bison grazed on the manmade savannas.

Though his lowland environment was fruitful, the Indian still saw value in the mountains rising above him. Following game trails, he easily gained the upper elevations, where he hunted deer, bear, and elk. As in the valleys, he

Artifacts found in Madison Run Rock Shelter show that the cave was used by Indians.

found that he could encourage and concentrate game by burning the forest on some of the more level mountaintops, producing grassy openings dotted with berry bushes and small trees.

Such a place was Big Meadows. The open expanse one now looks out upon from Byrd Visitor Center probably owes its origin to Indian fires. In the early morning or evening hours, we can easily imagine a bronze form behind a tree at the edge of the meadow, pulling back a bowstring and sending an arrow into a grazing buck. With a little more effort, we can see a line of braves following a great circle of fire around the meadow, driving a milling herd of terrified animals to their death.

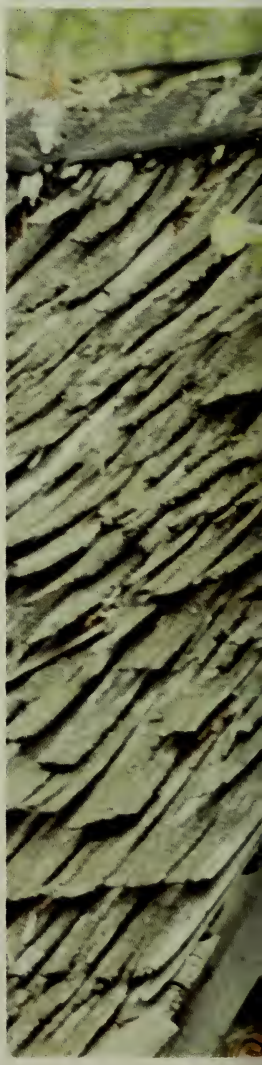
In our day of swarming population and all-powerful technology, we rightfully worry about man's relationship with his environment. Is he destroying it, and himself with it? And sometimes we wonder if our predecessors had better ways of living with the land. Indians, it is safe to conclude, lived with the Blue Ridge for centuries without destroying it, all that time drawing food, clothing, and shelter from its many forms of life. They had, of course, some constraints built into their way of life that we don't have. One was a low density of population, which was dictated by high death rates, the difficulty of storing surplus food, and perhaps self-imposed limits on their numbers. Another constraint was the nature of the tools they had to work with: bows, hoes, and stone axes certainly can't compete with guns, tractors, and bulldozers as resource-exploiting implements. (Fire, in their hands, could be considered productive rather than destructive, maintaining grass and shrubs but not burning deeply into the soil.) The Indians were thus too few and too ill-equipped to have long-term deleterious effects on the land. But though their situation and ours are not really comparable, we can still learn from them. We can learn, as Indians did from direct dependence on the natural world, to understand and respect the many forms of life and their environments. For our dependence, though obscured by the complex organization of modern society, is no less real.

Man Lives on the Mountain

On March 18, 1669, John Lederer left his horse with an Indian guide somewhere at the eastern foot of the Blue Ridge and climbed to the top of a high mountain. "Here did I wander in Snow, for the most part, till the Four and twentieth of March, hoping to finde some passage through the Mountains . . . .", he wrote. But he became discouraged, and returned eastward. Since he left a written account of his explorations, Lederer now gets credit for being the park area's first non-Indian visitor.

What sort of landscape did Lederer see during his ridgetop wanderings? He tells us little, but probably it was not much different from today's, though with more impressive forest on the lower slopes, and perhaps more openings on slopes and ridges, made by fires. Game certainly abounded. He saw deer, and "on the hillsides, Bear crashing Mast like Swine." Bison, elk, wolves—all now gone—he could have seen. The Indians were leaving a rich estate.

When President Franklin Roosevelt, on July 3, 1936, ascended the Blue Ridge and drove to Big Meadows (on the partly completed Skyline Drive) to



Remains of some mountain homes, like this one at Nicholson Hollow, can still be seen in the park.

dedicate Shenandoah National Park, he saw a still beautiful but a poorer landscape. In the more rugged hollows, deep forest with many big trees remained; but most of the slopes bore half-grown trees, the valuable timber long-gone to sawmills, and many open fields remained on mountaintops, gentle slopes, and flat-floored hollows. Between Lederer and Roosevelt, many men had climbed the mountains, lived here, and left their mark.

The flow of settlement, which followed explorers, trappers and traders, moved simultaneously westward across Virginia into the eastern foothills of the Blue Ridge and southward from Pennsylvania into the Shenandoah Valley, reaching both areas around 1730. The first land taken was probably that already opened up by Indians, grazing animals, and beaver activities. Occupation of the mountain hollows probably came later, since most of these would have required clearing before crops could be raised. Taking first the more fertile and level land at the mouths of hollows, settlement (mostly by Scotch-Irish, Irish, English, and Germans) then usually proceeded up-hollow, until the narrowing, steep-sided stream

valleys forced a halt.

These early mountain folk found nature generous. Once they had cleared some land, using the Indian method of killing trees by girdling and then burning, the fertile soil gave them good crops of corn, beans, squash, cabbage, and tobacco, as well as grass for their livestock. The forest gave them game, chestnuts, walnuts, berries, and wild honey for the table, furs for clothing and trade, and wood for cabins, fences and fireplaces. Springs and streams provided water. The sheltering slopes protected them from the worst of winter weather.

Later arrivals had less productive land to choose from, and many opted for gap or ridgetop locations, where slopes were gentle but weather rough. As roads were built through the gaps, some people became toll-takers here. In such places one could graze cattle, plant fruit trees, and scratch out garden patches—as most mountain families did. Nearly always there was a spring just below the gap. The prevailing westerly winds which often howl through these dips in the ridge made an east-side homesite more comfortable than a west-side one.

Ridgetop sites were perhaps the most difficult. Good grazing could be established in these places, and many people kept the livestock of valley-dwellers as well as their own here in summer. Crops could be raised on the more level land, such as Big Meadows. But the climate was tough—subzero winds and deep-piled snow were not what the pioneer from the Virginia lowlands or ocean-moderated Europe was used to. Water usually had to be carried uphill. Settlement on the ridgetops hinted that a land pinch was beginning.

Around the middle of the 19th century, the forests began to mean money in the pocket as well as direct supplies for the family. A market for lumber (mainly oak, chestnut, yellow-poplar, and pine) brought small sawmills to the heads of hollows, to which many a mountain farmer mule-dragged trees cut from his land. About the same time, a market for tanbark also developed. (The bark of chestnut oak and hemlock, and both bark and wood of chestnut, were used in the tanning of hides. The tannery at Luray used chestnut oak bark until 1952.) The trees were cut in spring and early summer when sap was running; the bark was peeled, and the logs generally were left. Some of the old roads in the park, whose traces can still be seen, were built to sled tanbark and haul logs.

The highwater mark of lumbering in the Blue Ridge came in the two decades after the Civil War. A great local demand for lumber, created by Gen. Philip Sheridan's scorched-earth practices in the Shenandoah Valley during

the war, and a more distant demand, served by a growing rail network and large timber companies, decimated the remaining stands of virgin trees. Only the stunted, ice- and wind-pruned trees on ridgetops and the big but inaccessible trees in steep, rocky hollows escaped cutting. By the 1920's, even such precipitous places as Whiteoak Canyon were being eyed. The few giants we see today were saved by the roughest of topography or by human protection. George Freeman Pollock—who built Skyland and avidly promoted establishment of a park—steadfastly refused to allow lumbering on his land, thus preserving many magnificent trees in such places as Whiteoak Canyon and Cedar Run.

Human impact on the Blue Ridge probably reached its zenith about 1900. By then, virtually every piece of land that would produce anything was occupied, and pastures and gardens had replaced as much of the former forestland as they ever would. But by then, living on these mountains had for many become a marginal existence. The soil was losing its fertility from too little rest and rotation; in some places it was washing away. Along with the depleted condition of soil and forests went a depleted supply of game—particularly the larger animals, such as deer, bear, and turkey, which were all either gone or extremely scarce. Reduction of forests had no doubt contributed to the disappearance of bears and turkeys, which require extensive woodlands, and year-round hunting had pressured all three.

The mountain people were pinched not only by the land they had oversettled, but by the economy of rural America. More and more, living required cash,

and there weren't many sources of that in the hollows. As the century moved on, lumber and fur markets deteriorated, and the chestnut blight began wiping out that food-and-money tree.

So the exodus began. Between 1900 and 1925 perhaps half of the residents left the park area. With their departure, the forest began its return—a slow but continuous process that was further encouraged by the establishment of Shenandoah National Park in 1935, when the remaining families were required to leave and a new way of using the land began.

Today the ring of axes is heard only in campgrounds, and the tinkle of cowbells nowhere, but under the ever-deepening green canopy lie everywhere the signs of an earlier life. Fallen stone walls, rotting chestnut rails, and rusting barbed wire snake through the forest under blankets of creeping vegetation. Old roads, now hardly discernible, wind down ridges and hollows. And rectangular foundations, slow to allow plant growth, show us where our predecessors chose to live. Apple trees, young pines and locusts, and stands of fast-growing yellow-poplars mark former orchards and pastures.

Looking at these traces of mountain life, one cannot help wondering what it was like. Was it a good life—independent, fruitful, inspirited by the high blue horizons? Or was it a spiritless struggle for survival? I suppose it was both—for mountain people, like those in any community, were varied in talents and fortune as well as in resources. Talk to Ranger Roy Sullivan, who as a boy in Simmons Gap sometimes shot 30 rabbits in a day and sold them to the local storekeeper at 25 cents apiece, or to District Ranger Bob Johnson, whose family made a good living on Piney Branch of the Thornton River; you will come away with a certain nostalgia for the good old days. But read *Hollow Folk,* a sociological study of life around 1930 in hollows near Old Rag, and you are depressed by the semi-human state that isolation and poverty had produced here.

Men live in mountains the world over, but few societies have been able to inhabit them densely without gradually destroying their soil. In the Blue Ridge, the land was good to the people, as long as they were good to it, but in the end there was too much abuse, and the land rebelled.

Return of the Natives

The June afternoon was overcast and still as I left the fire road and picked my way quietly through brush to the stream. At the head of a long pool, I stopped. A beaver was swimming toward me. I watched motionless as the animal, a pebble-toss away, climbed the bank, nibbled some plants, then returned to the water and swam to the far end of the pond, where it disappeared behind a large stick lodge. Later in the afternoon, I saw another, foraging in a pool just a few feet away from me and apparently oblivious to my presence. And in a third pond, a half-grown beaver showed me his underwater swimming techniques. It was an afternoon to remember.

The presence in the park of this colony, which had constructed some 10 dams and six lodges, illustrates the ceaseless impulse of animal populations to spread and occupy land. If the right habitats are available and the animals receive some protection, their recovery of former territory can be rapid. Several species originally native to the park area were wiped out. But with protection and some planned reintroduction, most have returned in considerable numbers.

As we have seen, the park landscape in 1935 was a patchwork of field and second-growth forest. There were sizeable areas of forest, to be sure, but open pasture occupied about a third of the land. This pattern of habitats was good for rabbits, quail, grouse, foxes (particularly the red), and a number of other small animals which like open country or forest edge. Most of the smaller mammals which live here today, such as skunk, opossum, raccoon, and red and gray squirrels, were here then. Bobcats, which require large tracts of wild land, had somehow persisted, no doubt aided by their extremely wary nature. Ravens and the big, showy pileated woodpeckers were here, too, though in smaller numbers than now.

Not so fortunate were some of the larger animals. Deer, which could have flourished in the patchy Shenandoah environment, had been exterminated. Bears, though occasionally seen, were no longer regular members of the animal community. Turkeys were apparently gone. And beavers were definitely gone. Establishment of the park eventually meant new territory for these four species. It had varied implications for other species, depending on their individual requirements.

Actually, Shenandoah offers little prime habitat for beaver. They prefer to eat aspen, birch, and alder, species that seldom occur in large stands here. The streams flow through steep, narrow valleys, which generally preclude the creation of large ponds. Yet in the last 30 years beavers have persistently tried to colonize the lower reaches of several park streams. And they have had some help. In 1938 a pair was released somewhere in the north section,

and in 1939 another pair was released on Jeremys Run. All but one of these animals died or were killed. The fourth was last seen in 1940 on Hughes River, where it had been taken after a brief career of cutting apple trees around Sperryville. At various times State game people have released beaver on the Shenandoah, Rapidan, or Rappahannock Rivers. The fresh cuttings seen in 1951 along Big Run, in the south section, perhaps were made by a wandering beaver from the Shenandoah River.

Recent beaver activity has been confined to several east-side streams in the northern half of the park. Beaver probably will never thrive in Shenandoah, but their efforts are interesting to watch.

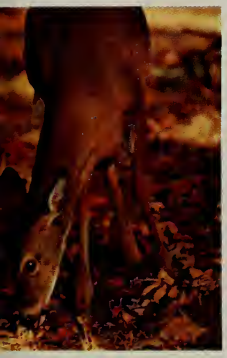
Nowadays it is no trick to see 15 or 20 deer in a night-time trip along Skyline Drive; but in March 1934, they were reportedly absent from the park area. The strong comeback of white-tailed deer began with 13 animals brought in late 1934 from the Mount Vernon Estate and released along Big Run. Then, about 1938, deer were reported crossing to the north section of the park from the Massanutten Mountains, where they also had been stocked. From these small beginnings, the deer population increased steadily until today they may be seen anywhere in the park. Present estimates, which are only educated guesses, run from a few hundred to a thousand.

The increase of deer in the park, as in many other parts of the east, has been greatly aided by the prevalence of second-growth forest. Deer prefer forest edge and young forests because here grows a variety and abundance of food that they can reach—herbaceous plants and leaves of shrubs and trees in summer, twigs in winter. As trees grow toward maturity, their lower branches tend to die, and the increasing shade they create makes it impossible for many plants to

A fresh-cut sweet, or black, birch shows that beavers are again active in the park.

White-tailed deer, once exterminated, have returned to the park and are now thriving.

grow beneath them. Thus deer find it harder to find or reach food as forests age. At present, Shenandoah is still fair deer habitat, with many acres of young forest, some open areas, and many still-surviving apple trees (whose fruits deer munch with great relish). The park's deer population may well be at or past its peak, however, since the forest trend goes against the whitetail.



Thus far, no conspicuous browse lines (created by heavy browsing of lower branches) have appeared in Shenandoah's forests; this indicates that the park is not overpopulated with deer. Without its former predators (cougar and wolf), and without hunting in the park, why doesn't the deer population explode? The consensus of local observers is that excess deer move downslope out of the park. Many of these, along with some that normally range at the lower elevations, are taken by hunters beyond park boundaries. The narrow shape of the park is thus a factor in regulating its deer population.

Considering this animal's food habits, deer watchers will have the best luck where there are openings in the forest. Try Skyline Drive early in the morning, in the evening, or at night—deer feeding times—or visit Big Meadows or the Loft Mountain area. One of these places is almost sure to produce.

The return of the black bear was unassisted. Bears are great wanderers, and apparently the first to appear in the park came in from the mountains to the west, where a few had survived. In 1937 two were reported in the park, and by 1944 the estimate was ten. In 1951 the bear population was placed at about 30, ranging over all parts of the park but most evident in the south sections. Recent estimates range from 50 to more than 150—a population that must be near the park's carrying capacity. Since the black bear is adapted to deep forest, its numbers will probably remain stable into the future.

The black bear's increase in numbers has been accompanied by an increasing boldness. Only a few years ago, it was unusual to see a bear; now each campground has regular customers that work the trash-can circuit and investigate campsites for any food left about. Bearproofing of trash receptacles and better-informed campers are expected to alleviate this problem, so that bears will be educated to stick to their normal food—roots, berries, fruits, and whatever vertebrate and invertebrate animal life they can catch.

Unlike those in colder climates, Shenandoah's bears do not sleep all winter, but during bad weather they do sleep for short periods in caves or thick brush. Numerous tracks in the snow attest to their

winter activity. Hugh Crandall had a startling encounter with a winter-active bear during the 1969 Christmas Bird Count. While bundled up against the cold and shuffling along on snowshoes over two feet of snow, he heard a branch snap behind him. He turned to see a charging bear—which then, recognizing its intended quarry as a human, bounded off into the forest. Normally, black bears avoid mankind.

In winter or early spring the tiny cubs, weighing less than a pound, are born. The usual litter is two, but sometimes one or three are born. By late summer of the following year they are big and wise enough to go their own way.

Privileged indeed is the hiker who has the chance to watch a mother bear foraging with her cubs, or even to see a bear galloping off up the mountainside. Much more usual are the signs they leave—broad footprints in snow or mud, large droppings on the trail, overturned rocks and logs, or chewed-up trail signs (The latter are less in evidence since adoption of the practice of wreathing signs with barbed wire).

A fourth success story concerns the wild turkey. Some of these birds apparently drifted back into the park from restocked areas outside, and some were planted by the Park Service in the north section. As with bears, they were first seen most often in the south section but now range park-wide. Using information in Mosby's *The Wild Turkey in Virginia,* I would guess there are 300 to 500 turkeys in the park.

Turkeys usually occur in flocks, each of which ranges over an area of several square miles. In winter these flocks generally are all-male or all-female. During the breeding season in spring, females disperse to nest, while first-year males either roam together in small groups or attach themselves to a breeding gobbler. Through summer and fall, the larger flocks are generally hens with their broods, while smaller flocks may consist of non-breeding hens or of males. The staple food items—acorns, berries, and seeds—are supplemented in summer by insects. Because of the wariness of these birds, turkey-watching is a chancy business. But by walking the less-frequented trails early in the morning, you might improve the chances of seeing them.

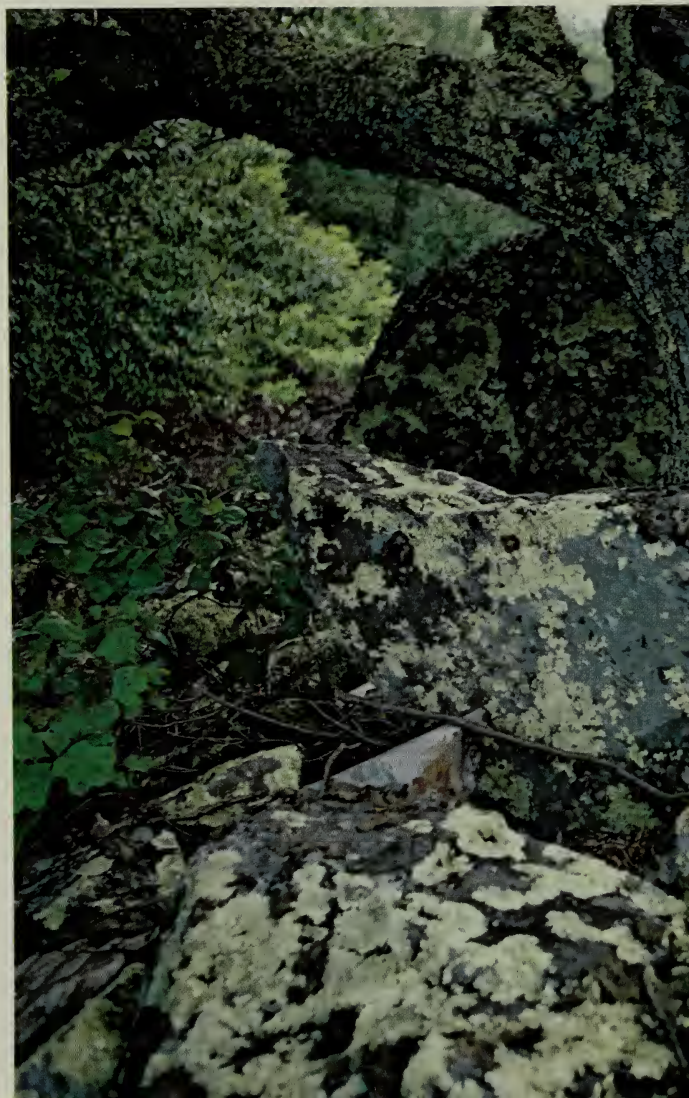
Another former inhabitant—the cougar—may have returned in a very modest way. Recurring reports of these big cats in the park keep alive the hope or fear (depending on one's interest) that they are back; so far, though, no dead animal or photograph (the scientist's confirmation) has been obtained. Some of the sightings are difficult to refute, but they could possibly have been of escaped animals. Convincing reports from

Great Smoky Mountains National Park and Blue Ridge Parkway, farther south, lead me to believe that cougars have made a small comeback in the southern Appalachians and do occasionally wander into Shenandoah. But the park's narrow shape does not favor their reestablishment here.

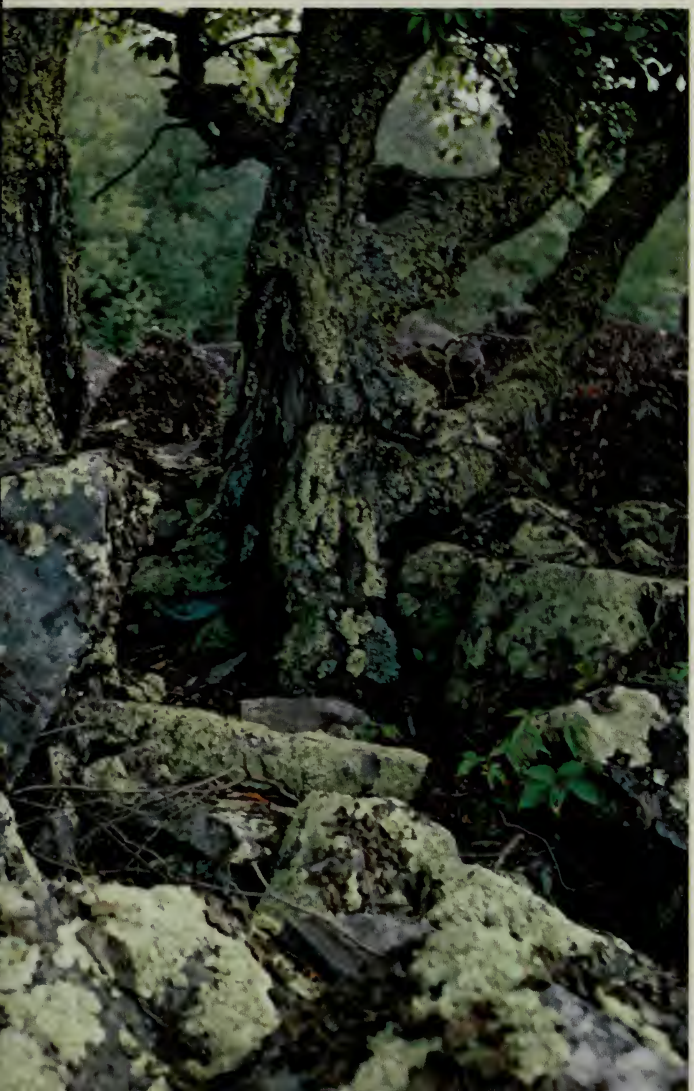
As we have seen, not all the former natives came back. Bison, wapiti ("elk"), and wolves were exterminated long ago, and probably none of these will roam Shenandoah forests again. The eastern bison, a woods animal, became extinct. The wapiti, if reintroduced, probably would not do well here because of the narrowness of the park, and would compete with livestock outside the park. (It was once, with only temporary success, restocked in forests around the Peaks of Otter, farther south.) Wolves, which would range out of the park, doubtlessly to the consternation of farmers, also make poor candidates for reintroduction.

At least one species—the peregrine falcon—has recently disappeared from the park's fauna, not because of direct persecution or through habitat destruction but because of our subtle poisoning of the American environment. Twenty-five years ago, one or more pairs of these swift, handsome birds nested on the park's cliffs. But widespread use of DDT and perhaps other pesticides after World War II gradually eliminated this species as a breeding bird throughout Eastern United States. The process of destruction begins with small organisms being sprayed directly or eating sprayed vegetation. At each succeeding step in natural food chains, the poison becomes more concentrated, since each level of organisms consists of fewer animals than the preceding level—the one on which it feeds. Predators at the end of food chains, such as the peregrine, get the most concentrated doses. In the case of the peregrine falcon and a number of other birds, including the vanishing bald eagle and brown pelican, enough poison is ingested to reduce calcium production, causing the birds to lay abnormally thin-shelled eggs which break or give the embryo inadequate protection. No park is an island, unfortunately, but is a part of the environmental "maine." A wide-ranging migratory bird like the peregrine cannot be completely protected in parks. So vulnerable is the world's small population of these falcons, and so persistent are some pesticides that it is doubtful that peregrines will ever again nest on the cliffs of Shenandoah.

Let us return now from this instance of failure to the many instances of success, and ponder more deeply the ways organisms are wedded to Shenandoah environments.



Life on the Rocks



Lichens, which encrust rocks and tree trunks in Shenandoah, can tolerate almost any conditions except polluted air.

Probably no Shenandoah environment is more hostile than its cliffs and the rock slides below them, which are scattered throughout the park. From its nest on a sheltered cliff ledge, the raven looks down upon a place that is at the mercy of the sun, heating rapidly by day and cooling rapidly at night. Whatever moisture falls on these jumbles of boulders, except that held in crevices or under the rocks, is evaporated by the sun or runs off down the steep slopes.

Yet even here there is life. Clinging to the face of the inhospitable rock, lichens exhibit a remarkable partnership in living. The main body of the lichen consists of a fungus, which provides anchorage to the rock and absorbs water, air, and mineral nutrients. The lifegiving partner is a green alga, whose cells are imbedded in the fungus. Using energy from the sun, its chloroplasts manufacture food for both of them from the substances absorbed by the fungus. Following closely in ability to make something from virtually nothing are mosses, which on level or shaded parts of the rocks can obtain enough water to survive. These pioneers gradually trap dust and

their own decay, until enough sustenance has accumulated to support ferns and small flowering plants such as stonecrop and saxifrage. Cracks in the rocks, acting as soil collectors, eventually sprout small green plants. Even some trees grow on a rock slide. The black birch is adept at colonizing such places, sending down long roots to find moisture and nutrients in the scant soil.

Animal life, directly or indirectly dependent on plants for food energy, must wait for them or their debris to occupy the rocks before moving in. Open rock slides where lichens are the only visible plants seem to be barren of animal life, but upon closer search you may find a small, pale-gray spider, whose color matches that of the rock. Where there are spiders —which are predators—there must be prey, I thought. But so far I have found only a few ants and flies that might serve as spider food in such situations; there must be other insects down under the rocks, taking advantage of small plants and litter.

Interestingly, the spiders on the dark, lichen-encrusted boulders at Blackrock, in the south section, are black. These may be either a different species or the same as those on light-colored rocks; for some spiders, like chameleons, can change color. In both cases, the rock-matching color camouflages the spiders from prey and predators.

Where the rocks lie on easier slopes, soil washed down from above can gradually collect between them. Here tiny gardens of moss, ferns, and other small plants develop, and with them a richer community of animal life. There are more insects and other invertebrates, and mice and woodrats may appear. One of the most interesting inhabitants of such vegetation islands in rock slides is the Shenandoah salamander, whose total known population is confined to the upper north sides of Hawksbill, Stony Man and The Pinnacles. Herpetologist Robert Jaeger, who studied this salamander intensively, found that it inhabits chiefly the edges of rock slides, where soil and litter have accumulated between the rocks,

The forest is advancing slowly on this Shenandoah rockslide.

and that a close relative, the red-backed salamander, takes over beyond the edge, where soil completely covers the rocks. This situation, Jaeger believes, represents the last stage in the history of the Shenandoah salamander as a taxonomic entity. Once, he thinks, the Shenandoah salamander occupied much of the Blue Ridge, but then for some reason the widespread red-backed salamander began extending its range into the mountains. By superior ability to compete for food the redback forced the former into the few pockets of talus it now inhabits. The redback, not as well adapted to dryness, cannot occupy the slide. Because of the competitive disadvantage, as soil gradually covers the rock, the Shenandoah salamander will probably become extinct.

The dwindling fortunes of the Shenandoah salamander again illustrate the dynamic character of nature, where change is the rule. A longer-term process than the covering of rock slides with soil and the disappearance of their salamanders is the actual breakdown of rock into soil. The soil on which land life depends is composed mostly of tiny rock particles, the end result of thousands of years of freezing, thawing, wind and water erosion, and even the prying action of growing roots, all of which reduce large rocks to smaller and smaller pieces. To these inorganic particles are added decaying plants and animals, upon which millions of small organisms feed. The soil is thus an amalgam of living and non-living things, with rock particles providing some of the mineral nutrients for plants growing from the soil. The next time you see a great, "ageless" boulder lying in the forest, think of this: it will be home and sustenance for some far-future life.

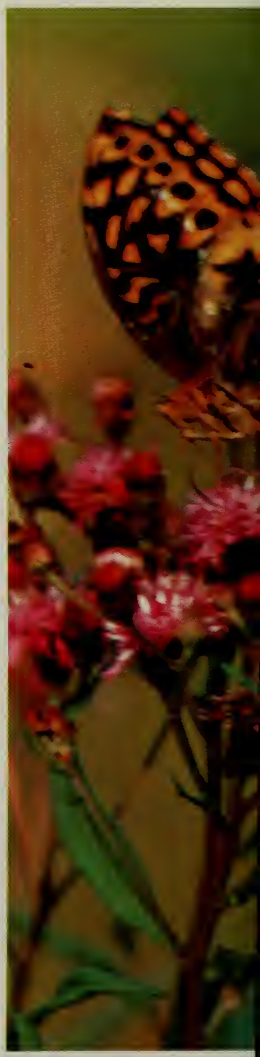
In this part of the world, forest is usually the last step in the plant-and-animal succession that begins with rock colonization and soil formation. In Shenandoah we can see various stages in this progression, since man with his cutting, burning and livestock grazing has set back the successional clock. Rock, meadow, brush, pioneer forest, and mature forest—each has its distinctive plants and animals, which fade and are replaced as each stage gives way to the next.

The drama of each community and its passing is a tragicomedy that can spellbind. Part of its grip on a discerning audience no doubt lies in the knowledge that we too are involved. For we are as inextricably tied to our environment, world-wide though it may be, as any spider on a rock. And if our environment becomes unfit for us, we will, as surely as the Shenandoah salamander on its shrinking rock slide, face extinction.

Manmade Grasslands

Traveling south on Skyline Drive through mile after mile of forest, one dips into Fishers Gap, climbs a few hundred feet, and then breaks out into a startling expanse of open meadow. Like a pioneer coming out of long dark forests into a settled place with fields, a hiker feels delight bordering on relief upon reaching Big Meadows. And the delight lingers and deepens if you wander out into it, for Big Meadows is a place to dream, and a place to watch an ever-changing kaleidoscope of life.

This opening in the forest is the largest of the few remaining in the park. Since the 1930's, when about a third of Shenandoah was pasture, the forest has reclaimed nearly all of these grassy expanses. The extent of the change in habitats is well illustrated by the status of the song sparrow, a bird of open brushy places. As recently as 1950, Alexander Wetmore (ornithologist and then Secretary of the Smithsonian Institution) reported it as fairly common in the park. Today, I know only one place where song sparrows nest —in the bushy center of Big Meadows. In farmlands at the foot of the Blue Ridge, song sparrows are numerous; in the park the returning forest has forced them out.



Big Meadows, then, is a man-made island of grass in a sea of forest. Probably first formed by Indian fires, it later served as pasture and cropland for settlers. Today, some 300 acres south of Skyline Drive are maintained in an open condition by fall mowing, so visitors can see how a large part of the park once looked. This is only a fraction of the original Big Meadows, which extended from Milam Gap to Fishers Gap, and north of the Drive to the present campground site.

Plants and animals are not particular about how their environment was made—whether by man or climate—so some of the inhabitants of Big Meadows are the same ones you might find on an Illinois prairie. Meadowlarks and vesper sparrows sing from low perches. A few smooth green snakes, slender little creatures with beautiful bright green backs, hunt insects and spiders in the camouflaging grass. The deer mouse, a species which has occupied both woods and prairies, follows runways through the herbaceous jungle. And the plants that make a home for these animals are mostly sun-loving types, among which grasses, sedges and composites (the daisy family) are prominent. A humming, flitting swarm of bees, flies and butterflies feeds on the nectar of the meadow flowers and ensures their pollination.

In addition to these typical grassland species, many plants and animals more characteristic of other habitats are also found here. Hay-scented, swamp and bracken fern form clumps about the meadow, as do blackberries, and the white spikes of fly-poison punctuate the summer scene. In spring, the short vegetation reveals woodchucks, newly returned from winter dens in the woods; but as the plants shoot up they hide these rotund brown rodents. Chipmunks, more typical of forest, can sometimes be found in the meadow. Deer often venture from the woods in the dim hours to graze. And a host of birds that nest elsewhere come here to feed. You may see robins, flickers, starlings, and cowbirds feeding on the ground; ruby-throated hummingbirds sipping nectar from milkweed blossoms; and a variety of swallows picking insects from the air. Though only knee- or waist-high at its late-summer peak, the meadow vegetation obviously supports a lot of animal life.

But nature does not want a meadow here. The climate is

suited for forest, and forest keeps trying to exploit the potential of the site. The blackberries that may scratch your legs on a meadow walk are one vanguard of woodland. Without mowing, they would crowd out much more of the herbaceous vegetation. Down in the grass you may notice the sliced-off stems of black locust, a pioneer tree that invades open places and adds quantities of nitrogen to the soil. And scattered about the meadow are small pine seedlings, which also do well in open sunlight. The wet center of this grassy bowl is marked by thick clumps of gray dogwood and hawthorn, still other forerunners of forest. If given a chance, all these woody species would eventually take over much of the meadow and in time create an environment too shady even for their own offspring. They would finally give way to some of the shade-tolerant trees of Shenandoah—oaks, hickories, ash and others—with perhaps a few hemlocks and white pines. In 75 years this transformation to forest would probably be complete.

Along with invading plants come animals of the brushland. Around the edges of Big Meadows, where small clumps of woody plants have succeeded, field sparrows sing and bobwhites call. Woodcocks, which like open spots among shrubs for landing pads during their courtship flights, can be heard "beeping" here on spring evenings. At least one pair of gray foxes has had a den at the edge of the meadow, well situated to exploit a variety of habitats. Skunks, too, like edge situations; they are often seen in the Big Meadows area at night, investigating roadsides, campsites, and the Park Service residential area, as well as more natural settings. Among reptiles, the garter snake is probably the most common inhabitant of such halfway stages between grassland and forest, though it may be found almost anywhere.

A similar army of invaders is closing in on Patterson's Field, the long grassy saddle between Loft and Big Flat mountains in the

The smooth green snake normally feeds on insects and spiders, but this 2-foot specimen at Big Meadows appears to have dined on larger prey.

The rufous-sided towhee favors brushy fields and forest edges.

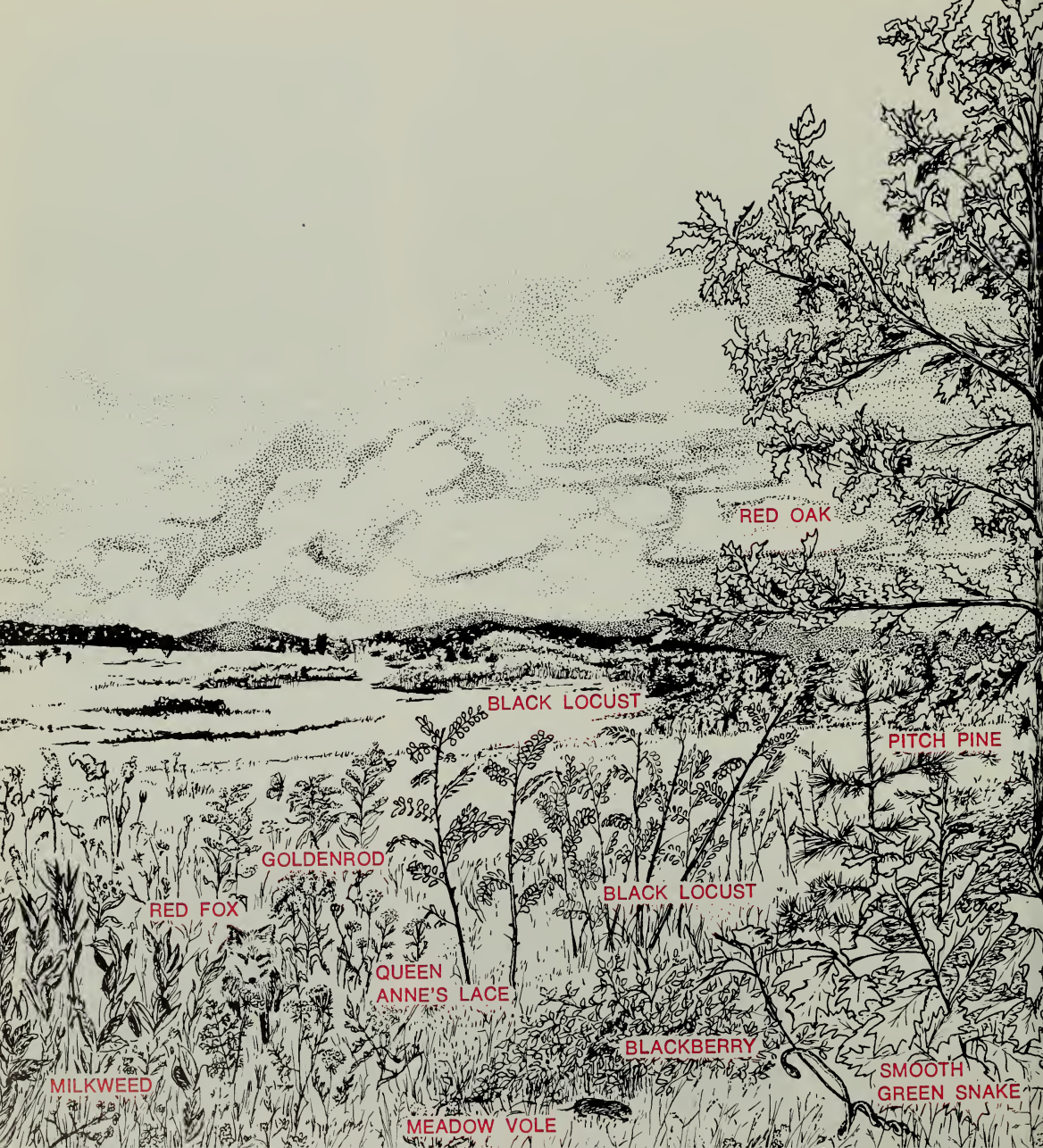
southern section, and the only other sizeable opening in the Shenandoah forest except for Skyline Drive itself. Sumac, black locust, and pine creep up the sides of the saddle out of older forest of oak, maple, and hemlock. Towhees, catbirds, brown thrashers, field sparrows, bobwhites, and that crazy songster the yellow-breasted chat sing from the shrubbery. Chipmunks and cottontails feed and watch warily for the broad-winged and red-tailed hawks that often soar over this opening. Deer forage through the fringing brush. On one visit, a beautiful, red-blotched milk snake wound through the grass ahead of me, and on another I chanced upon a garter snake which had captured a toad by its hind end and was slowly working it down its throat. Here, too, bees, wasps, flies, and butterflies feed and hunt among the summer flowers.

This happy hunting ground, now only a narrow strip between encroaching forests, is the legacy of generations of mountain people who pastured livestock here. This was, in fact, the most recently pastured place in the park, and that explains its openness. In the early 1930's Herbert Patterson and his son Allen grazed several hundred Hereford cattle and about 30 horses on 2,200 acres here. They drove the stock up from the Shenandoah Valley in spring and drove them down in fall, two drives each way. The mountain was obviously good to the Pattersons. The greenstone that caps the ridge here made good soil that nourished good grass for the Pattersons' Herefords. Today this soil produces good forage for wild livestock.

The roadsides along Skyline Drive can hardly be called grassland or meadow, since they are vegetated mostly with closely mown grass and scattered trees and shrubs—a linear suburban yardscape, as it were, created along the Blue Ridge crest. But many animals of brushland or forest like to feed in this open strip through the woods. Woodchucks, rabbits, and deer nibble the grass. Robins and chipping sparrows feed

Butterfly in Big Meadows Swamp

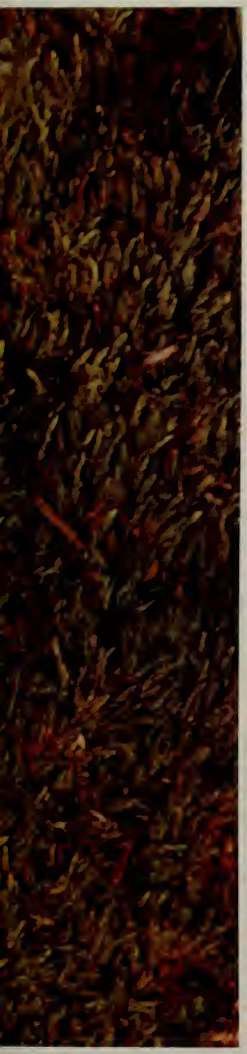
The deer mouse may be the most abundant mammal in the park.


RED OAK
BLACK LOCUST
PITCH PINE
GOLDENROD
RED FOX
BLACK LOCUST
QUEEN
ANNE'S LACE
BLACKBERRY
SMOOTH
GREEN SNAKE
MILKWEED
MEADOW VOLE

along the ground. Ruffed grouse stand frozen by the roadside while cars pass. At night your headlights may pick out a skunk or gray fox searching the grass, and you may flush a barred owl or woodcock from the pavement itself (do these last two find food here, or do they just enjoy the stored warmth of the day?). And summer and fall the Drive has an ever-changing display of flowers that rivals Big Meadows'. All this assortment of life shows again the attraction of forest openings for plants and animals.

Within a generation, Patterson's Field will probably disappear under forest or a lodging development. That will leave Big Meadows as the only reminder in the park that man made some grasslands in these mountains, and only here will be found some animals of the open places. Gradually, in the rest of the park, the locusts, pines, sassafras, sumac, and apple trees that now mark the locations of a hundred old fields will be shaded out, and finally the forests of Shenandoah will return to the primeval condition of pre-Indian days, perhaps to be opened up only by an occasional wildfire. This is the dictate of nature, and in national parks, nature rules.

Variations on a Forest Theme



Hardwood forest, with its animal inhabitants, is obviously the dominant natural theme in Shenandoah. But within this theme are variations wrought by both nature and man. A walk to South River Falls, in the central section near Swift Run Gap, takes us through a forest sequence that well illustrates some of these variations, and climaxes at one of the park's most beautiful waterfalls. So let's go there!

It is June, and as we leave the South River picnic grounds we pass through a tangle of locust, black cherry, persimmon, dogwood and grapevine. The leaves are fully out, and animal life is at a peak of activity. Down the trail, a thick stand of Virginia and pitch pine marks a former pasture. The songs of towhees and chestnut-sided warblers, as well as the tree species, proclaim this an early stage of second growth. A rotting rail fence and occasional rock piles tell us that man was responsible.

Now we step into the pines. In little openings among the trees, grassy patches from pasture days remain. But scattered here and there we find a few seedlings of yellow-poplar, hickory, ash, oak, and sugar maple—the beginnings of a future forest.

Returning to the trail and following it downhill, we come to a sudden change in the forest. At an old rail fence, where the slope pitches downward more steeply, the young growth on the former pasture ends, and tall oaks begin. We guess by their foot-thick trunks and 80-foot height that they are 50 to 60 years old. We see no pines or locusts among them. Perhaps, then, this steep mountainside was logged shortly after the turn of the century, and seedlings of the cut trees began to reproduce the original forest. A few old sawed-off stumps bolster our theory. We continue down the switchbacking trail into these taller woods.

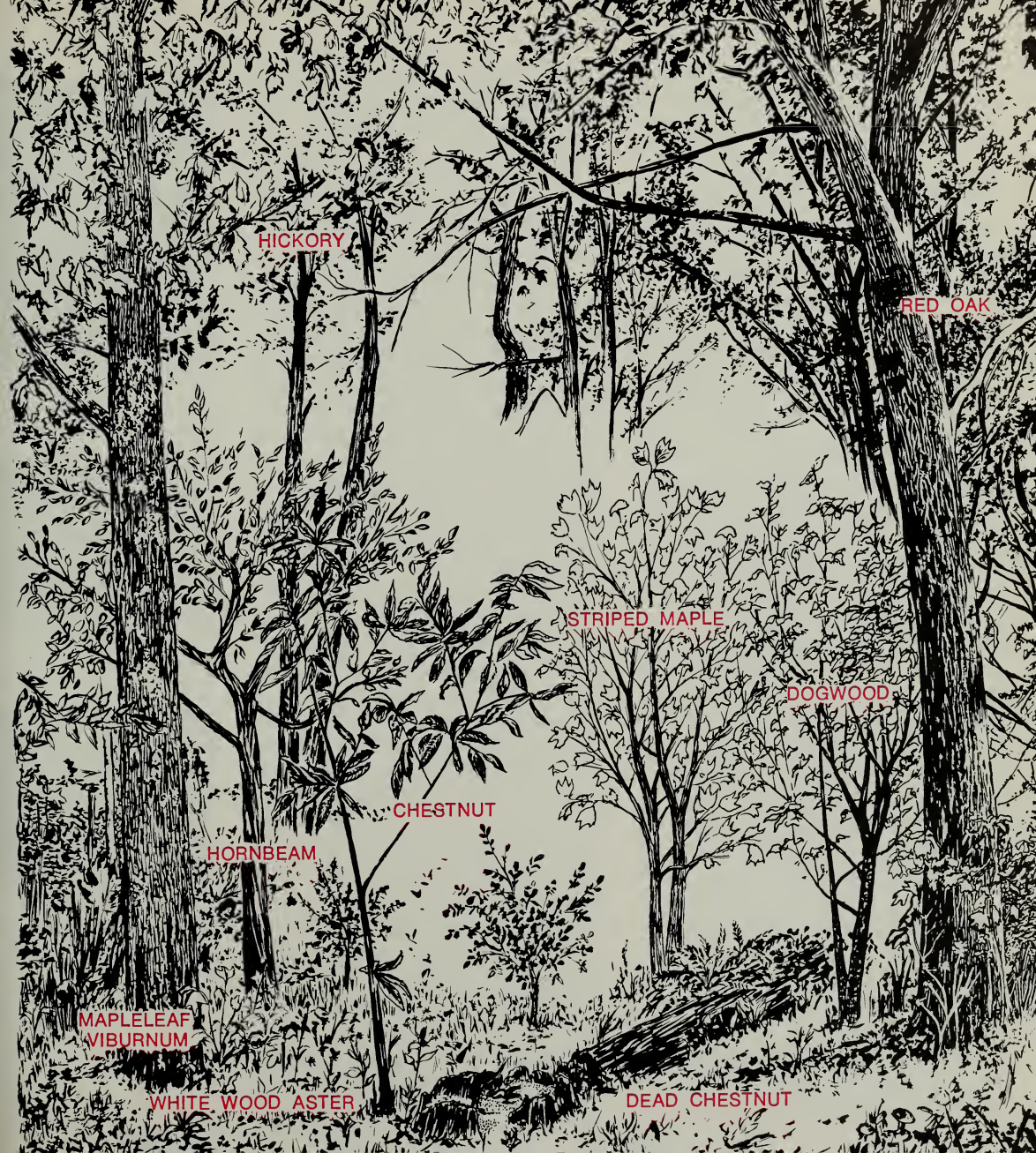
Now a boulder beside the trail invites us to sit. Looking up, we see a maze of leaves against the blue sky, and we pick out the different trees by the shapes of their leaves—the pointed lobes of red oak leaves, the wavy-edged leaves of chestnut oak, the four-pointed mitt of the yellow-poplar. We search harder and find a few pointed leaflets of hickory and ash. Round about us, on our own level, we see an understory of small hickories, black birch, dogwood, redbud, and sugar maple. The ground cover is rather

open, but there are seedlings of some of the larger trees as well as of maple-leaved viburnum. Beside the trail, Christmas, hay-scented and maidenhair ferns spread their lacy fronds. Now that the spring burst of wildflowers has passed, and the leafy forest roof has closed, little is blooming on the forest floor except a few Gray's penstemons, wild hydrangeas and bluets. But some plants without chlorophyll—ghostly-white Indian pipes and brown-stained squaw-root—are pushing up. Obtaining nutrients from decayed material or roots of living plants, these fleshy saprophytes are freed from direct dependence on sunlight.

We shut our eyes and let our ears investigate the forest. They pick up the voices of the red-eyed vireo, scarlet tanager, wood pewee, wood thrush, downy woodpecker, ovenbird, and redstart. A chipmunk, suddenly aware of our presence, squeaks nearby. The rustle overhead is a gray squirrel, springing from tree to tree.

All this seen and heard life, along with a great deal more unseen, unheard life, is part of a complex forest community, each of whose members exploits the forest's resources in a different way, all living together in a shifting equilibrium of competition and cooperation. One reason so many forms of life can live here is that the mature forest provides a diversity of micro-habitats. The gray squirrel spends much time in the canopy, eating buds, nuts, and seeds of trees. Up there with him is that glowing red ember with black wings, the scarlet tanager. This bird, along with others, feasts on a great assortment of insects —such as moth caterpillars, leaf miners, and aphids—that live on tree foliage just under the surface of the canopy. Red-eyed vireos nest and do much of their feeding in the forest understory, hanging their neat little basket nests from forks of branches. The wood thrush generally nests in shrubs, such as spicebush, and hunts food on the ground, while chipmunks make their homes in burrows or under rocks or logs, and feed from the ground up into shrubs and small trees. Restricting most of its operations to the ground layer, the ovenbird builds its domed nest and feeds among the leaves of the forest floor, flying to higher levels only to sing.

At ground level, most animal life is secretive and tends to escape the notice of the casual observer. But turn over a rotting log and


HICKORY
RED OAK
STRIPED MAPLE
DOGWOOD
CHESTNUT
HORNBEAM
MAPLELEAF VIBURNUM
WHITE WOOD ASTER
DEAD CHESTNUT

you may find a little ring-necked snake, eater of small prey such as insects and worms. An even more likely find under that log would be a red-backed salamander. Herpetologist Jaeger considers this the most abundant vertebrate in Shenandoah National Park and possibly in the eastern United States. He estimates that, where the ground surface does not dry out, there is one redback for each 2.9 square yards in the park, and five redbacks if the subsurface area is included. This salamander coexists with such larger ground-dwelling predators as the ring-necked snake by taking smaller prey. On wet nights it extends its hunting territory by climbing shrubs and trees.

If we searched a long time on this slope we're descending, we might also find a copperhead, well-camouflaged in the leaves by the hour-glass patterns on its reddish-brown back. A white-footed or deer mouse, venturing out of its nest to hunt for seeds, would have to be sharp-eyed indeed to notice the copperhead, lying motionless in wait.

As we near the last switchback going down to the stream, we notice some sugar maples and basswoods among the oaks and hickories—a good sign that the soil holds more moisture here. And below the last switchback, another trailside rock offers a place to sit and enjoy the coolness, shadowy mystery, and music along the stream. Shafts of sunlight pierce the canopy to light the silver-gold trunks of yellow birch, the furrowed, red-brown trunks of aged hemlocks, the cracked, platy trunks of sweet ("black") birch. Spots of sunlight fall too upon mossy boulders bearing gardens of ferns and small flowering plants. Through the boulders burble many little channels of South River, here in its infancy. The stream's music is accompanied by songs of the Louisiana waterthrush and is punctuated by the calls of a phoebe, an Acadian flycatcher, and numerous chipmunks. A red squirrel chatters at us from a hemlock branch.

The richness of life in this stream valley can hardly escape us. If we look carefully about, we see an even greater variety of trees than on the slope above. Besides the hemlock and yellow and sweet birches, there are sugar and red maple; red, white, and chestnut oak; yellow-poplar; hickory; ash; basswood; butternut; black gum; and American and hop hornbeam. Insects, some of which dance above the stream, are more abundant here, too. We have descended along a gradient of increasing soil moisture, depth, and fertility to a sort of vegetational climax in this hollow.

Now as our eyes swing upslope behind us, they catch an anomaly in the forest pattern. Here, instead

The barred owl lives in the deep woods of the coves and stream valleys.

The red- backed salamander feeds on small invertebrates.

Though the ringneck snake is common, its small size and secretive habits make it an inconspicuous part of the forest community.

The white-footed mouse feeds on seeds, nuts, and insects.

The gray squirrel prefers forests of oak, beech, and hickory.

The copperhead is well camouflaged when in its normal habitat, the leaf-strewn forest floor.

of scattered big trees, we see a thick stand of young sweet birches, some draped with grapevines. We walk up to investigate. Aha! Here is a depression in the hillside, outlined by leaf-covered rocks; near it is a smaller one. Someone a few generations ago, liking this spot as much as we do, built his home here, and beside it dug a root cellar. Sometime after he left, sweet birch seedlings claimed the opening, and leaf litter and the infinitesimal creep of soil began to return the slope to its original contour. Perhaps in another couple of generations only an expert eye will be able to discern that man once disturbed the forest here.

Pleased with our sleuthing ability, we watch more carefully for clues to the nature of this community as we walk down the hollow. Suddenly, among the roots of a big yellow birch, which burrow into the soil like huge banded worms, we see white droppings and fragments of crayfish shells. Who was here? Probably a barred owl or broad-winged hawk sat in this small dead tree beside the birch and regurgitated these indigestible parts of crayfish taken from the stream. For both of these woodland birds eat aquatic animals as well as mice and other land animals.

Thinking about these winged predators, which hunt over many acres of slope and valley, we wonder about some of the other large animals that surely wander this South River country. The forests in this valley are too grown up to provide good browse for deer. Hoofprints along the stream tell us, however, that deer have come here to drink. Perhaps on our way we will find the fur-filled droppings of a bobcat, which might very well have a den in the rocks on these steep slopes. Bobcats, seldom seen because of their shyness and nocturnal habits, are nevertheless considered fairly common in the park, especially at the higher elevations. Rabbits, squirrels, mice, and birds form most of their diet, though like many predators they will eat almost anything they can catch, even occasionally a deer. No doubt, too, a flock of turkeys roams these slopes, scratching among the leaves for acorns and insects. It takes a bit of luck to spot turkeys, and usually the glimpse is brief as the wary birds trot rapidly off.

But the animal that most captures our thoughts is the black bear. Along the trail we have seen characteristic droppings and decaying logs that have been torn apart—evidence that one has been here. But as usual the maker of these signs does not appear. Nevertheless, his felt presence lends excitement to our walk.

From thoughts of bears we return our focus to the forest around us. Having admired the

diversity of life along the path, we begin to be aware that death, too, is part of the forest scene. Uprooted giants lie moldering on the slopes; trees felled long ago by man leave their tell-tale stumps; and others, snapped by the wind, hang in their neighbors' branches.

Fire, too, has taken a toll. Blackened stumps and tree bases show that fire has long been a fact of life in these forests; it can come again any time.

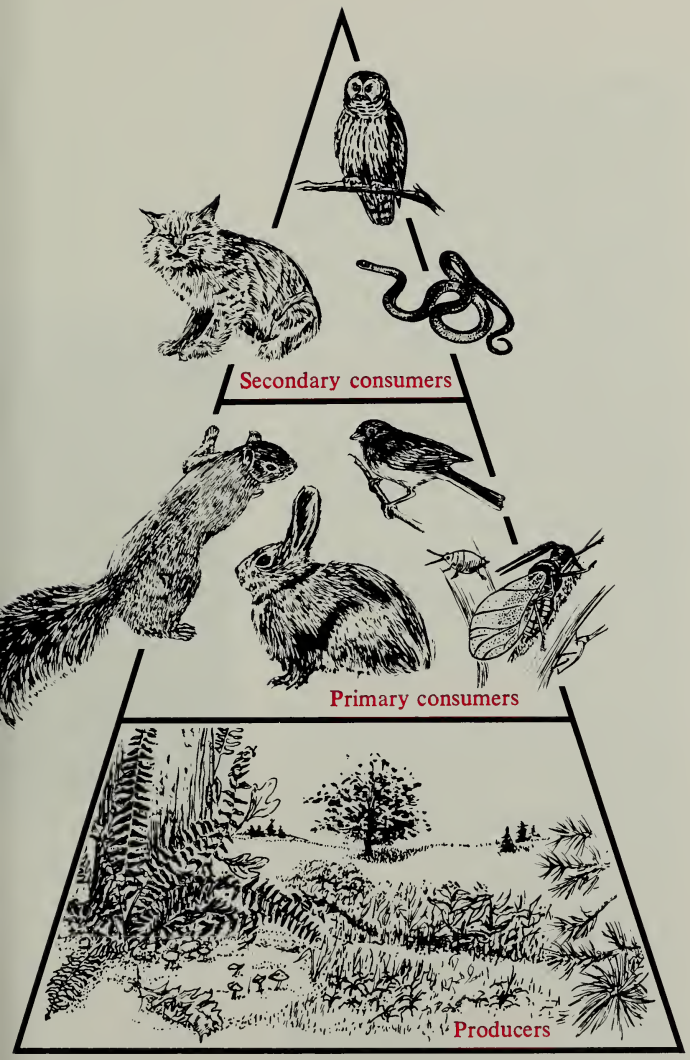
Among the principal agents of tree destruction are insects and disease, often working together. The most devastating tree disease ever to hit North America was the chestnut blight, caused by a tiny fungus. Introduced around 1900, it wiped out virtually every mature chestnut tree in America by the late 1930's. Once abundant in Shenandoah, the chestnut exists now only as gray, twisted stumps and logs, and as sprouts that grow from the surviving roots only to die after a few years. In these South River forests and elsewhere, many of its bleached skeletons stand in dignified death among their living associates, preserved this long by the tannin in their wood.

Many other diseases and insects attack Shenandoah's trees, but most are taken in stride as part of an environment to which these tree species have become adapted over the centuries. Usually it is a foreign invader, such as the chestnut blight, that is not part of the native system of checks and balances, that proliferates and causes real devastation. But trees, like people, must die somehow. As a tree ages, its ability to heal wounds and grow new leaves decreases. Fungi, bacteria, viruses, and insects eventually block its food- and water-conducting vessels or strip its foliage, thus ending its life.

The death of animals, though continual, is a less conspicuous part of the forest drama. Disease takes many. Starvation and severe weather take some. Accidents take a few. (Once, on Big Run, I found a water snake that had crawled into a hollow limb and then tried to crawl out before its back half was in; the snake got stuck in the hole and died.) Predation accounts for a great many animals. Eating and being eaten is a very important part of natural regulation, usually helping to prevent any species from getting out of hand to the detriment of the rest. However death comes to an animal, it usually comes early, returning that organism to the great revolving

The Shenandoah Food Pyramid

Because there is about a 90% loss of energy in each stage of the food chain, it requires about 1,000 pounds of green plants to produce 100 pounds of plant eaters. When taken as food, these 100 pounds of plant eaters will produce only 10 pounds of animal eaters. Thus, any plant-and-animal community contains a much greater mass of green plant material than the total mass of plant eaters. And there will be a much greater mass of herbivores than carnivores.



fund of the forest.

Death in the forest, whether it be of trees, worms, or chipmunks, means life for the next generation. All the nutrients taken up through the soil or obtained by eating plants or animals now return to the soil. An army of visible and microscopic organisms, such as bacteria and fungi, keeps all this substance in circulation by ingesting dead plant and animal matter and converting it into chemical forms which can again be used by living things. Without their help, the supply of nutrients, such as nitrogen and phosphorous, in dead organisms would remain locked up, and life would cease. Thus the billions of minute soil organisms, though least noticeable, are perhaps the forest's most important inhabitants.

Thus far, the forest has captured our attention, but now the stream takes center stage. After a half mile of many-channeled meandering through its flat-bottomed valley, it now narrows into a rocky slot and quickens its pace. It cascades over boulders and finally, emerging from the forest shade, leaps into the sunlit opening of South River Falls. We exult in its moment of freedom. On our return, past other discoveries of

human and animal occupancy, we are fueled by the memory of this scene, and are continually repaid for our exertion by the variety and beauty of forest life en route.

Our walk, starting at 3,000 feet elevation and dropping to 2,000 feet at the falls, has taken us through some of the richest forest in Shenandoah. Here coolness and fairly deep soil formed from easily-fractured, water-holding greenstone preserve moisture for plants. We have seen the more favorable end of the spectrum of Shenandoah forests. Slopes and ridges that are less sheltered, or face southwest or west, or lie upon sedimentary rocks, support less plant and animal life and may look much different. As conditions become drier, such trees as yellow birch, hemlock, yellow-poplar, sugar maple, and basswood drop out, and the forest becomes mainly one of red, chestnut, and scarlet oaks and several hickories. In the driest places, such as many of the quartzite ridges in the south section, pines and thickets of scrub oak take over. On the highest mountains and ridgetops, where moisture and soil may be favorable but exposure is severe, wind and the weight of ice create forests of stunted, twisted red and white oaks. Branches are continually being broken, so that they have no chance to grow long in one direction. Branches that venture above the general treetop level are sheared off by winter storms, so that from a distance the forest has a pruned, hedge-like appearance. Within, these forests have a mysterious, gnomish quality, especially on misty days, when forms are indistinct and the moisture turns the trunk-encrusting lichens green. If we follow environmental gradients to the coolest, wettest places in the park, such as Limberlost or the top of Hawksbill, we find such northern conifers as spruce and fir among the more temperate trees. All these variations in Shenandoah forests tend to occur gradually over space, individual species dropping out or coming in over several hundred feet of elevation change. From a distance, the effect of a seamless green robe prevails.

Because of its elevational range of 600 to 4,000 feet and its variety of topography and rocks, Shenandoah National Park displays much of the forest variation to be found in Eastern United States. Lucy Braun, who spent a lifetime

A hike to South River Falls will take you through some of the park's finest forest habitats.

studying the deciduous forests of eastern North America, classified these forests into nine regions: mixed mesophytic, western mesophytic, oak-hickory, oak-chestnut, oak-pine, southeastern evergreen, beech-maple, maple-basswood, and hemlock-white pine-northern hardwoods. Shenandoah falls within her oak-chestnut region, but the park contains most of the trees that typify the other regions except for those of the southeastern evergreen forest. The type with the greatest diversity—the mixed mesophytic —is approached in some of Shenandoah's hollows, such as the one we have just visited along South River.

Some places in the central section that rival South River in variety and size of trees are White Oak Canyon, Cedar Run, and the Rapidan River from Camp Hoover down. In the south section, the Falls Trail along Jones Falls Run and Doyle's River passes some giants. In the north section, the forest around the Elkwallow picnic area has a particularly pleasant diversity. But walk from any high ridge down into a hollow, and you will see much of the variation on Shenandoah's forest theme.

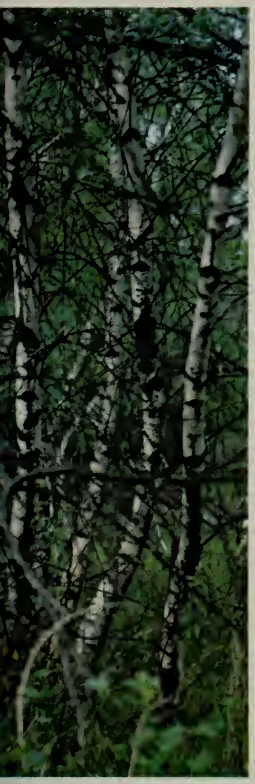
Elements of the North

Ensconced in my sleeping bag in a small clearing on top of Hawksbill, I contemplated the night. Overhead, a myriad stars speckled the black sky. Far down the mountainside, a barred owl uttered doglike hoots. Although it was June 22, the breeze coming in from the west across the mountaintop chilled my feet. Feeling the cool air and catching the faint scent of nearby fir trees, I returned in thought to the many nights I had camped in the Adirondacks, summers before. It was a natural association, because here on Hawksbill, at 4,049 feet the park's highest peak, lower temperatures and abundant moisture make a home for numerous forms of northern plant and animal life. I had come here to see what some of those might be.

The next morning, after a fitful sleep (made so by cold feet, the rustling of a raccoon—or was it a bear? —and deer mice scurrying everywhere, including across me), I relished breakfast and the scene about me. A few yards off, the mountaintop fell away in cliffs, making an open view far out into the Shenandoah Valley. Around the clearing, short, twisted oaks and scattered dark firs gave a secure feeling, while juncos fed unafraid on the ground nearby. A rabbit (possibly a New England cottontail rather than the more widely distributed eastern cottontail) nibbled quietly on grass at the edge of the clearing. Back in the woods a veery sang, while from a brushy opening nearby came songs of chestnut-sided warblers. When I walked out to the cliff edge to get a better view, I found the little three-toothed cinquefoil, which grows in rocky, sterile places from Greenland south—even, on high mountains, to Georgia. Springing from crevices below me were mountain-ashes, with their fronds of narrow leaflets. Mingled with these plants and animals were many others of more temperate range, but the place did have a northern flavor.

Most indicative of all were the firs and spruces. Scattered among the red oaks, yellow birches, and other trees on the upper few hundred feet of Hawksbill, balsam firs and red spruces up to a foot thick survive here on a climatic island that is similar to climates of New England and the high peaks farther south, where firs and spruces also live. Presumably, they were more widespread in the Blue Ridge during the last ice age, and

Big Meadows is the southernmost outpost of the gray birch, a northern species.



now with warmer climate have retreated to a few high-altitude spots. In southwestern Virginia and on down into the Smokies, there are lofty peaks that support sizeable forests of spruce and fir, which harbor animal life typical of this forest type. But Hawksbill is not high enough to have more than a sprinkling of these trees and thus lacks typical spruce-fir animals.

The transitional nature of the Hawksbill environment poses a problem for its northern conifers. Living as they do at the limit of their tolerance, could they withstand a series of warm, dry years? And does their precarious position make them more susceptible to disease and insect attack? One sign of health in a plant or animal population is vigorous reproduction, and in this respect Hawksbill's firs are doing well. You don't have to search long to find many seedlings beneath the parent trees. But look closely at the older trees and you will see a sign that may mean defeat. Toward the tips of many branches are bulbous swellings that mark the presence of the balsam woolly aphid, a tiny insect that sucks sap. Many other firs are dead, presumably killed by aphids. The spruces, though scarcer and less productive of seedlings, appear healthier. Perhaps in the long run, they will fit this environment better than their coniferous cousins.

My explorations that June day took me finally to the stretch of the Appalachian Trail that cuts across the steep north side of Hawksbill. This is a delightful, interesting, even spectacular walk that features all phases of the struggle of plants and animals (including our friend the Shenandoah salamander) to colonize and cover rocks. Along the way, on these cool, moist slopes, I found other species more typical of the north. There were Canada, blackburnian, and black-throated blue warblers, veeries, juncos (one with a nest beside the trail), rose-breasted grosbeaks, and red squirrels. Beneath a canopy of rugged old yellow and black birches, ashes, red oaks, sugar maples and basswoods was a thick growth of shrubs, among which striped and mountain maple and ninebark were prominent. Along the path I found trailing monkshood, not actually a northerner but restricted, from Virginia and West Virginia south, to the mountains. In that wild jumble of rocks and vegetation, I concluded, many "cool" things wait to be found.

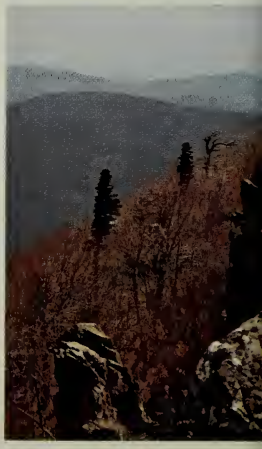
Seekers of northern life, of course, do not have to climb Hawksbill to find it. Many places above 2,000 feet have typical New England plants and animals, and some cool hollows carry such life almost to the foot of the mountains. But the higher places are better hunting grounds. Stony Man, at 4,010 feet a close second to Hawksbill, has much the same life. In addition, a few Canada yews grow here. Many of its spruces and firs, however, appear to have been planted, since these species are found mostly near trails between Skyland and the summit. Perhaps men of the Civilian Conservation Corps planted them back in the early days of the park, as they did the firs and spruces around Big Meadows.

Another "northern" environment is the Limberlost, a boggy area at the head of White Oak Canyon that is shaded by giant hemlocks and white oaks several centuries old. Hidden among the hemlocks a few large red spruces and a number of small ones attest to the elevation (3,300 feet) and the dampness. In the dark, acid world under these tall conifers, few plants grow. But here and there among the scattered ferns you may find blooming such northerners as Canada mayflower, bluebead-lily, and wood sorrel. The bird population has its cool-zone representatives, too: blackburnian warblers, with fiery-orange breasts and weak, sibilant songs; and veeries, juncos, solitary vireos, and black-throated blue warblers. Among more secretive forms of life, the red-backed vole, a mouselike rodent that ranges north to Hudson Bay, undoubtedly lives here.

Visitors to the southern section of the park can see a smaller edition of the Limberlost on the east side of Skyline Drive just north of the turn-off to Loft Mountain. Here, where a number of northern plants grow on a mossy floor under hemlocks, one can expect the same species of birds found in the Limberlost.

A very unexpected northerner grows in and around the swamp at Big Meadows. This is the gray birch, best known as a reclaimer of old fields in New England. The colony at Big Meadows is near the species' southern limit and is its only known occurrence in Virginia. Perhaps its presence here can be laid to long-ago fires, which created the sort of opening it needs. Big Meadows Swamp, though now sucked partly dry by wells and drainage ditches, still harbors other plants that range mainly northward. One of the

Scattered firs tower over a stunted oak forest on Hawksbill Mountain.



most conspicuous of these is Canadian burnet, which produces showy white flower spikes in late summer. Another is marsh-marigold, blooming yellow in April and May.

Although the higher elevations and greenstone underpinnings in the central section of the park have a large share of Shenandoah's northern life, medium elevations and sedimentary rock in the southern and northern sections claim most of the park's paper birch, another hanger-on at the southern limit of its range. Most of the 50-or-so clumps of birch are hard to find, but several are easily seen on the north side of the ridge trail leading out to The Neighbor, in the north section. Charles (Mo) Stevens, who has roamed the ridges and hollows of the Blue Ridge for years, found under one stand of paper birch a colony of bunchberry, the first record for Virginia of this primarily Canadian plant.

Ranging at all elevations but most often seen flying over high ridges, ravens impart a feeling of the Canadian wilderness. For in eastern North America ravens are found primarily north of our border in vast coniferous forests and Arctic tundra. The southern Appalachians, however, harbor a sizeable population of these big, black birds. Distinguished from their cousin, the common crow, by much greater size, heavier bill, and wedge-shaped tail, ravens also identify themselves from afar with hoarse croaks rather than caws. Subsisting to a large extent on carrion, they patrol Skyline Drive seeking road kills; but they take food wherever they can find it, whether this be on a berry bush, in a bird's nest, or crawling across the forest floor. In March they lay their eggs in nests on sheltered cliff ledges, and by April they are feeding young. All summer the adult ravens tend their airborne though still-dependent offspring. In winter, ravens seem to range more widely, sometimes appearing in the nearby lowlands and occasionally even on the coastal plain. Throughout the year, Shenandoah would hardly be Shenandoah without the soaring and aerobatics, the raucous sounds, and the clever ways of this wilderness bird.

All the forms of northern life persisting in Shenandoah are of secondary importance here, ecologically speaking; but they do represent one environmental extreme in the park, and they have a special attraction for naturalists from the warmer lowlands. What better way, indeed, to spend a June day than to climb Hawksbill seeking bits of New England?

The Fire Forest

A night fire burns upslope in Bacon Hollow.

Fire control aide Clinton Runyon got the word about 7 p.m.: a fire was burning on Dovel Mountain in the Central District. By 8 o'clock he had joined the crew in Steam Hollow, as darkness settled.

"First we tried to go up from Steam Hollow, but old-timers said it was easier to go around to Lucas Hollow and come up the fire trail. Nobody was in much of a hurry because down in the hollows it was raining hard, with big hailstones. But when we got on the ridge it was dry as tinder and we knew we had a fire." It was May 20 and the foliage was mostly out, making it hard to see. "First we got off on a wrong ridge and went two miles the wrong way. We finally got to the fire about 12:30 a.m.

Lightning had struck on the south side of Dovel Mountain and the fire was burning up and down the slope. It burned mostly on the ground, but when it hit laurel bushes "they popped and crackled like dry kindling." When it got into a stand of young pines, it flared up into the crowns.

The fire burned over the top of the mountain and down the north slope onto private land. Having already worked an 8-hour day, the maintenance men on the crew made "a pretty scratchy fire line."

In many places, bouldery scree slopes stopped it. When Chief Ranger Doug Warnock, who as fire boss had been tied to his command post, finally got to the scene about noon, he found the fire largely contained. Two days later, rain finished it off.

In all, some 94 acres had been burned, most of it in the park. This fire could be classed as larger-than-average for Shenandoah today, though it was small compared to some in pre-park days. It had, typically, burned mostly upslope and then, probably helped by down-hollow night winds, backed down the other side of the ridge. Largely a ground fire, it had consumed virtually all litter, low-growing herbaceous plants, and shrubs; but most trees had been spared.

Three months later, in August 1970, I followed the firefighters' route up Dog Slaughter Ridge to the scene of the blaze. The ground and tree trunks were blackened, and lower foliage of trees had turned dead-brown from the heat, but everywhere were signs of new growth. Blueberries, greenbrier, bracken fern, and sassafras seedlings had begun to blot out the charred floor with spots of green. From the bases of laurel and scrub oak, whose old stems had been killed, new shoots 1 to 3 feet long were growing vigorously. Similar sprouts ringed the bases of chestnut oaks. Though small Table Mountain pines appeared dead, the more common pitch pines, of all sizes, had responded with defiant exuberance. From their bases new stems sprang, and their blackened trunks and lower branches bristled with green needles. In a few years, the average person would never guess that a fire had burned here.

Every year, lightning- or man-caused fires burn patches of the Blue Ridge, as they have, I suppose, since forests first grew on these slopes. Nowadays, fire protection greatly restricts their damage, but past fires have burned a thousand acres or more of the park area at once, and virtually all of Shenandoah has been burned at one time or another. But like the fire on Dovel Mountain, they occur most often on south or west slopes where the forest is liberally sprinkled with pines.

The relationship between fire and pine-oak forests is a vicious (or at least self-maintaining) circle. Pines, being more drought-resistant than most deciduous trees, tend to grow on

rocky ridges and south- and west-facing slopes, where sun-heating effect is greatest. Along with some of the dry-slope understory plants, such as scrub oak and laurel, pines burn readily. Thus, fires starting on south or west slopes, having good fuel, are more apt to spread than those starting on wetter slopes. At the same time, thick bark or resistant root systems enables these dry-slope plants to survive. The pine-oak forests thus both encourage fire (which operates to exclude other trees) and successfully resist destruction by it. Thus they ensure their own continuance. Collectively, they can well be called "the fire forest." Another sort of pine forest, consisting of dense stands of pitch and scrub pines, and occasionally of white pines, sometimes develops on old clearings, as at South River picnic grounds. These have very little ground vegetation and few shrubs because the trees grow so close together. These stands develop because of the pines' ability to colonize open areas, not because of dryness of the site. They give way fairly rapidly to deciduous forest. The open but densely shrubbed pine-oak forests on southwest slopes, on the other hand, develop because of fire and dryness, and give way very slowly, if at all, to deciduous forest.

In leafless seasons, the pines on southwest slopes make conspicuous dark patches amid the prevailing oak forests of Shenandoah. These patterns are easily seen from many overlooks along Skyline Drive, particularly in the south section and in parts of the north section. In many ways, those dark patches represent another world within the forest cosmos of the mountains.

As we have seen, the world of the pine forests is one of dryness. Here, everything seems to conspire against retention of moisture. Although plenty of rain falls, it disappears rapidly. Long daily doses of sunshine evaporate it, or steep slopes direct it quickly downhill. Even the soil works against wetness. On quartzite ridges and slopes where much of the pine grows, the rocks weather very slowly into sand, like the material from which they were formed millions of years ago. Water that does not run off or evaporate percolates rapidly down through the porous sandy soil, leaving the surface dry shortly after the rain passes.

Plants that grow in such places must be adapted in some way to a shortage of water. Some, such as

Two months after the Dovel Mountain fire, chestnut oaks are sprouting vigorously.

Several years after a fire, Sawmill Ridge is covered by a dense growth of shrubs and young trees.

blueberry, huckleberry, and azalea, have small leaves, thus reducing the surface through which transpiration of water can occur. Others, such as scrub oak and laurel, have tough, hard-surfaced leaves, which help protect the inner cells.

Pine-oak forests differ from moist hollow forests not only in their adaptations to drought but also in their general structure. These are tough woods to walk through. Beneath the rather open tree canopy, thickets of scrub oak, laurel, azalea, huckleberry, and blueberry present a tight-woven web of woody stems that scratch and catch the bushwhacker at every step. It is hard to understand how bears, which come to these places in summer for berries and later for acorns, can bolt so quickly through these thickets. Scrub oak, in fact, is also called bear oak, no doubt because bears frequent places where this plant and its associated berry bushes abound.

Herbaceous plants, which face stiff competition for sunlight and water from the thick layer of shrubs, are rather scarce. You will find them mostly in the more open spots, as along trails. Many are spring-bloomers. Among these are turkeybeard, a grasslike plant of the lily family; two orchids—pink lady-slipper and whorled pogonia; dwarf iris; and bird-foot violet. Trailing arbutus, a dwarf creeping shrub, also blooms in spring; its relative, teaberry, blooms in summer. False-indigo and coreopsis, too, brighten summer trails. Bracken fern, characteristic of dry places, is another common plant of the pine-oak woods.

As the term we have used for these forests implies, oaks are an important constituent. Besides the shrubby scrub oak, there are many scarlet and chestnut oaks. Red oaks, less suited to dryness, and white oaks, most moisture-loving of all, are few or absent. You can, in fact, judge the dryness of a site by the species of oaks on it, with scrub oak at the dry end of the moisture spectrum and white oak at the wet end. Other deciduous trees often thinly scattered among the pines are black gum, red maple, sassafras, and serviceberry.

In this severe environment, the number of species of plants is lower than in moist areas. The same relationship holds true for animal species. Bird-watching, for instance, is not very productive in pine-oak forests. Besides mourning doves, which like open pine stands, and shrub-loving towhees and catbirds, few other birds are

attracted to these dry forests. In Shenandoah, however, two warblers seem largely restricted to this environment. The pine warbler, which prefers fairly tall pines, could be called an indicator species for the pine-oak forest type; the prairie warbler, which likes smaller, scattered pines, is most easily found here.

The reptiles, too, are poorly represented in the pine-oak community. Fence lizards (the commonest of the park's few lizards) seem to fit this environment best. Timber rattlesnakes, though perhaps more common in wetter woods, are sometimes encountered in dry, rocky forests, where they prey on birds and such small mammals as white-footed mice, woodrats, and chipmunks. If you can suppress your fear of rattlesnakes, you will find them not at all ugly. Timber rattlesnakes come in two color phases: black and yellow. The black phase ranges from dark brown with darker banding to completely black, its sombreness matching its reputation. But the yellow phase, with dark bands against a yellowish background, is truly handsome.

Rattlesnakes and copperheads are not often encountered in the park, but when out walking you should always watch the ground in front of you, and avoid putting your feet or hands where you can't see. The proper attitude toward poisonous snakes is one of respect. Leave them alone and they will leave you alone. Like all species of wild animals, they are protected by law in this national park.

Most of Shenandoah's pine-oak forests are out on side spurs of the Blue Ridge backbone, somewhat removed from Skyline Drive. A couple of good examples of this forest type, both in the south section, are easily reached. One is a few hundred yards east of the Drive along the north side of the Moorman River fire road, near Blackrock Gap. Another straddles the Drive at Sawmill Run Overlook. By following the Appalachian Trail south from its crossing of the Drive, just north of the overlook, you can traverse this distinctive, pine-dominated forest without fighting its inhospitable thickets. On this area, burned in 1947, oaks, red maples, and other deciduous trees persist in their effort to oust the pines. But chances are they again will be thwarted by fire, which someday will come crackling and popping up the mountainside through the dry shrubs.

Biography of a Stream

Much of the rain and snow falling on the wrinkled back of Shenandoah National Park eventually nourishes its numerous streams. This water seeps out of the ground in springs where men have drunk for centuries. It drops over ledges in lovely waterfalls. It shelters a fisherman's prize, the brook trout. And it means life for a host of aquatic plants and animals. Though Shenandoah has no water bodies larger than mountain brooks, these give special beauty and a voice to the forest, and offer the naturalist a new realm to explore.

Thanks to outcroppings of resistant greenstone, many of the streams take vertical plunges in their upper or middle courses. Trails lead to the more spectacular falls as well as to many lesser ones. Whiteoak Canyon, with its six waterfalls and ancient hemlocks, is perhaps the most scenically rewarding of the stream valleys. Dark Hollow Falls, on Hogcamp Branch of the Rose River, besides being pretty has the virtue of being the closest—only 0.7 mile—from Skyline Drive. Overall Falls (near Matthews Arm campground), South River Falls, and several on Jones Falls Run and Doyle's River (south of Loft Mountain) also rank high in

scenic quality. Many streams without notable waterfalls nevertheless make delightful hiking companions. Among the favorites in this category are Jeremys Run, Hughes River, North Fork of the Moorman River, and Big Run.

A number of the park's animals are found only in or near streams or boggy places. Turn over a submerged rock or stick and you are likely to find attached to it the cylindrical cases of caddisfly larvae. The larvae reach out from these little cases (made of sand or plant debris) to feed on material that washes by. Amazingly, each species can be identified by the type of case it builds. Nymphs of stoneflies and mayflies are common associates of caddisflies in the underwater world. Patrolling the surface of quiet pools, water striders feed on small insects that fall into the water. Aquatic bugs and beetles hunt between surface and stream bottom.

Crayfish creep slowly along the bottom of park streams, or hide under rocks and debris. Feeding on organic material, these crustaceans are eaten by a variety of larger animals, including water snakes, barred owls, broad-winged hawks, raccoons, and mink.

With two feet in the water and two on land, as it were, most amphibians (frogs, toads, and salamanders) must have water for breeding and egg-laying, and some spend all their lives in or near water. The park's most common aquatic salamanders are the northern dusky, two-lined, and spring salamanders. Pickerel and green frogs can often be found at springs and along streams, especially in quiet pools, while toads may be encountered almost anywhere, though they go to water in the breeding season.

Salamanders are under cover and difficult to find during the day, but at night they are active and unafraid. For a different sort of nature experience, try finding them with a flashlight at night along streams, on wet rocks, and in springs. You should be able to watch them at close range as they go about their business.

Early each spring, an amphibian ritual takes place in a pool in the Big Meadows swamp. Soon after the ice melts, wood frogs and spotted and Jefferson salamanders migrate to this pool to mate and lay eggs. A knowledgeable amateur herpetologist, William Witt, who has watched this ritual for several springs, finds that the three species segregate themselves. The wood frogs lay their eggs in the southeast part of the pool, the spotted salamanders around the edges, and the Jefferson in the middle. After a short period of activity—with loud quacking of the wood frogs providing the music for the nuptial "dancing" of the spotted salamanders, followed by laying and fertilization of eggs

—the three species disappear. The salamanders go underground for the rest of the year and the wood frogs disperse into wooded areas. For the people at Big Meadows, another spring has begun.

For the fisherman, of course, the park's most interesting aquatic animal is the brook trout. Some 46 of the park's streams support these fish, and for a few days after opening of the trout season their banks are well trodden. The most illustrious trout fisherman to visit the park was Herbert Hoover, who in the twenties built a retreat on the Rapidan River. Some of these rustic buildings are still maintained for visits by high government officials, and the trout in their lovely setting of boulder-washing cascades and sheltering hemlocks are still there. In most years, brook trout can be found in the higher waters, but soon after streams leave the park they become too warm to support these cool-water fish. If you approach a deep pool quietly, you may see trout hovering near the bottom against the current or lying nearly motionless under a log or rock waiting for prey. Their companions in the pool may be dace, darters, suckers and sculpins, all of which are common in the park. Some of the larger streams contain bass and sunfish in their lower park reaches.

A few birds and mammals are closely tied to water. The Louisiana water-thrush can be seen teetering on the streamside rocks or, more often, heard singing its musical accompaniment to the gurgling of the brook. Kingfishers work the lower reaches, where the fishing is best. Beavers, muskrats, and mink, all rare and local in the park, spend much of their lives in the water. Raccoons, common everywhere near streams, search there for crayfish and frogs.

Shenandoah's short, steep streams are highly vulnerable to the effects of drought and flood and thus provide an unstable environment. During very dry summers, most of them shrink to a series of disconnected pools. Fish trapped in these pools, enervated by a dwindling oxygen supply and rising temperatures, become easy prey. Robert Lennon, studying Shenandoah's trout, often observed water snakes preying on fish in isolated pools during the drought in the summer of 1954. Although other fish were more numerous, the snakes seemed to attack mostly brook trout, perhaps because these were the largest and were more debilitated by the high temperature. Floods, especially those during otherwise dry periods, can also wipe out many stream animals. Occasionally, hurricanes or other storms dump several inches of water on the Blue Ridge in a few hours and send rampaging torrents down the mountainsides, sweeping away anything in their

paths, even large boulders.

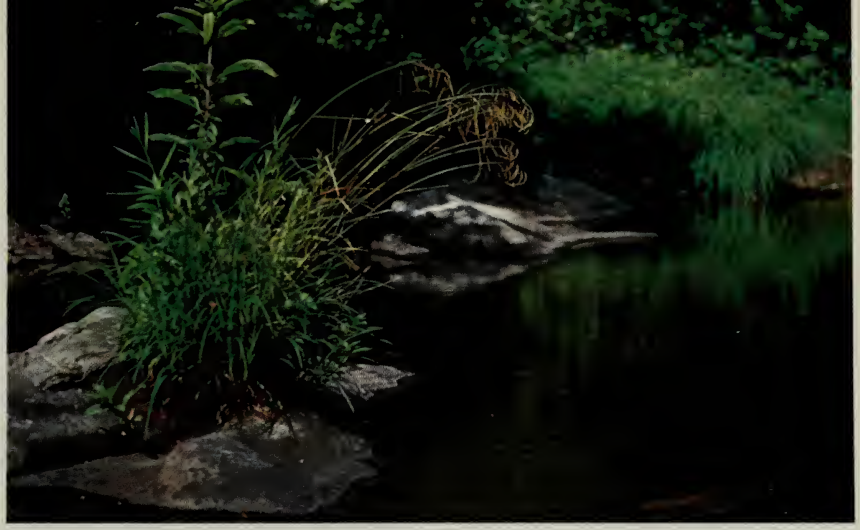
Recovery from the effects of drought and flood is usually rapid, however. Dr. Lennon found that within 2 years after the 1951–54 drought, brook trout and other fish had repopulated long stretches of streams. Fish food organisms, such as mayflies and stoneflies, no doubt recovered even faster.

One can see a good cross section of Shenandoah's terrestrial, as well as aquatic, life by following a stream from its headwaters high on the Blue Ridge to its exit from the park. Many streams offer this sort of biological spectrum. One of my favorites is the south section's Big Run; this stream seems to have more life in it than do most. Though it is pathless in its highest reaches, about 5 miles of Big Run is accompanied by a fire road.

Born in greenstone, maturing in quartzite, sandstone, and shale, and dying in Valley dolomite, Big Run changes character with each few hundred feet of drop. Like many streams, it has several beginnings. The highest source, at about 3,000 feet, is a spring beside a large boulder along the Drive near Loft Mountain Wayside. From here the water seeps and trickles down a slope covered with young red maples and yellow-poplars interspersed with open, wet, fern-filled glades. As it gathers water in the upper end of Eppert Hollow, it gradually attains identity as a stream, with a consistent channel and a continuous voice. Here small stands of hemlock and yellow birch, mixed with oaks, sugar maples, and yellow-poplars, shade wet, mossy rocks. Juncos add to the northerly atmosphere. In the brook, crayfish and dusky salamanders hide under the stones.

About 1 mile below the Drive, the juvenile Big Run drops about 10 or 15 feet over a ledge of greenstone. The scene here is decidedly primeval. Great gray rocks guarded by giant hemlocks enclose the stream. Patriarchs of the past molder where they fell. The day Park Naturalist Frank Deckert and I visited this remote, shady glen, we found a weathered, rodent-chewed antler lying in the leaves. Who knows how many winters ago some old buck dropped it here? Now it seemed a perfect capstone to our experience of this wild place.

From this secluded stretch the stream hurries down to a tributary ravine which enters from the north. Here the pools contain brook trout during normally wet summers. The trees look smaller, perhaps indicating that cutting was more recent here than on the steeper slopes upstream. The first mosquito descended on us as we ate lunch. Herbert Hoover had specified that his fishing retreat must be above 2,000 feet to escape mosquitoes, and that limit must have been reliable. Our topo



Big Run's quiet pools are good spots in which to look for wildlife.

map placed us at 1900 feet.

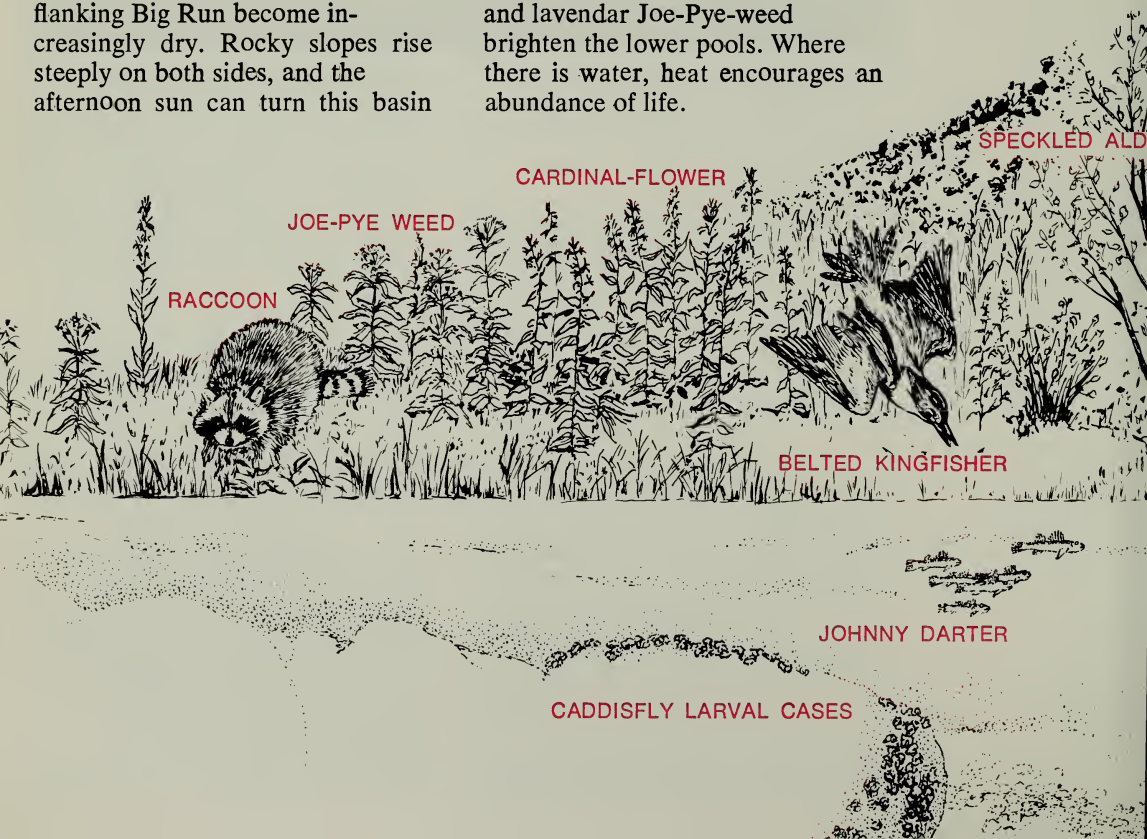
From here down to its junction with the other main fork of Big Run, the stream descends more gradually and takes on new characteristics. Oaks predominate in this forest, as they do in most of Shenandoah. The sprinkling of sugar maple we had found above now dwindled and virtually disappeared, and we noted only two yellow birches in a mile and a half. Instead of numerous hemlocks, we now found big white pines; and white-barked sycamores began to appear. Other small fish shared the stream with the brook trout, and occasionally frogs plopped into the pools. Near the mouth of Eppert Hollow, through which this major fork flows, we saw for the first time some alders along the banks. They signaled another change in the character of Big Run.

From this junction downstream, and back up the other major fork for about a half-mile, Big Run is a succession of long pools bordered by alders and willows and connected by short tumbles over sedimentary ledges. These pools generally harbor an interesting variety of aquatic life—trout, dace, darters, white and hog suckers, mottled sculpins, and, below the fire-road bridge, bass and bluegills. Aquatic insects include water striders, whirligig beetles, dragonflies, and the larvae of caddisflies, mayflies, and stoneflies. The spring salamander seems common; less so does the Blue Ridge red salamander, a subspecies of the northern red possibly introduced into Big Run by fishermen. Green frogs give their guitar-twang calls from some of the quiet, grassy shallows. Searching the pools for frogs and fish, water snakes weave sinuously

across and under the surface. To sun, they climb into streamside bushes and debris, where they blend into mottled background. (These are *not* water moccasins; that poisonous species ranges no farther north than the very southeastern corner of Virginia.) And patrolling these fish-filled stretches of Big Run is an occasional kingfisher, which signals its presence with a loud, rattling call.

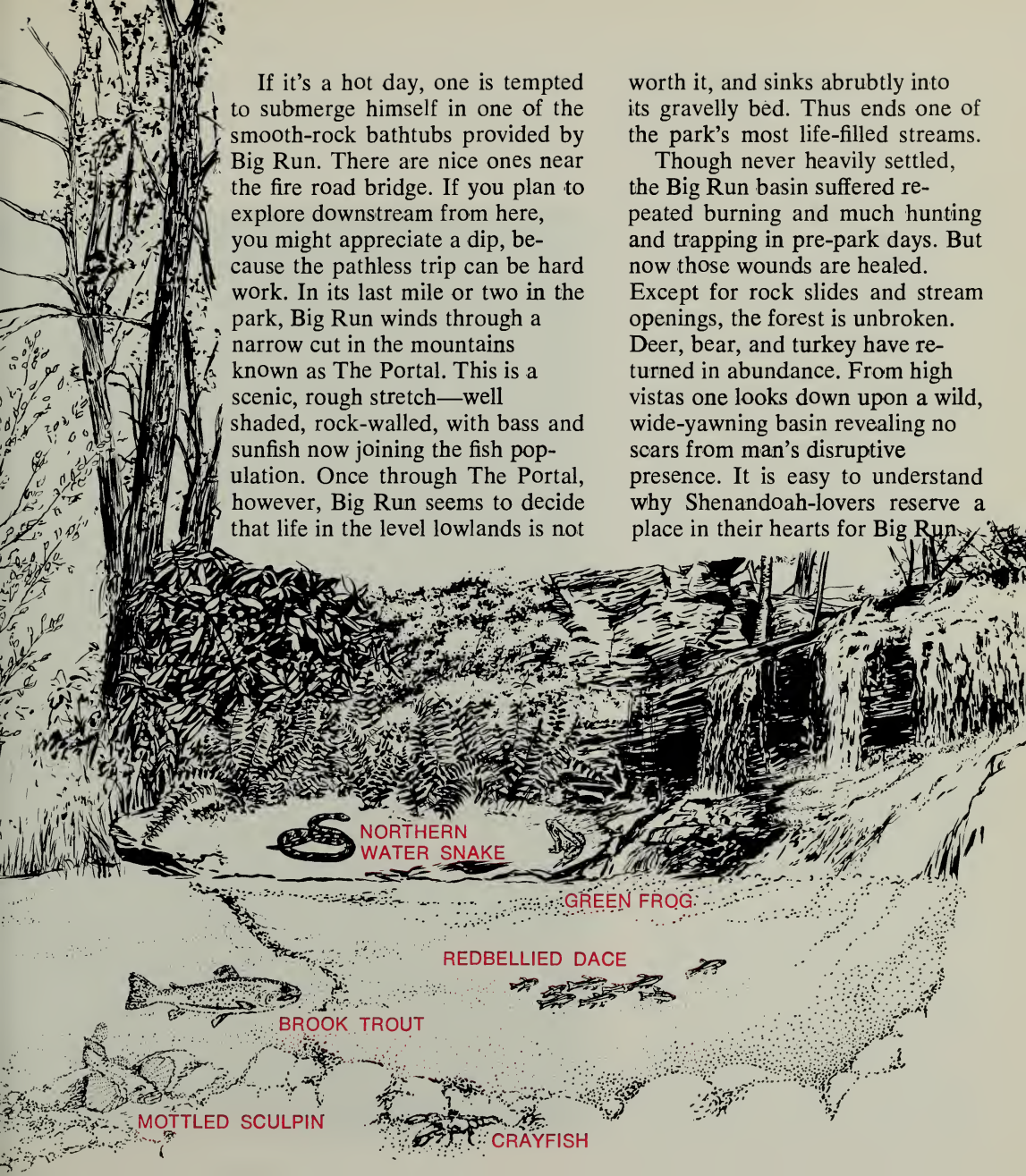
From the mouth of Eppert Hollow on down, the forests flanking Big Run become increasingly dry. Rocky slopes rise steeply on both sides, and the afternoon sun can turn this basin into an oven. A heavy sprinkling of pines in the predominantly oak-hickory forest attests to the dryness. Pitch and Table Mountain pines are common in the upper parts of the basin, but in the lower reaches many Virginia pines also appear. Only along the stream does moisture-loving vegetation survive. Here tall white pines add their shade and stateliness, and twisting sycamores gleam white through the greenness. In late summer, scarlet cardinal flower and lavendar Joe-Pye-weed brighten the lower pools. Where there is water, heat encourages an abundance of life.

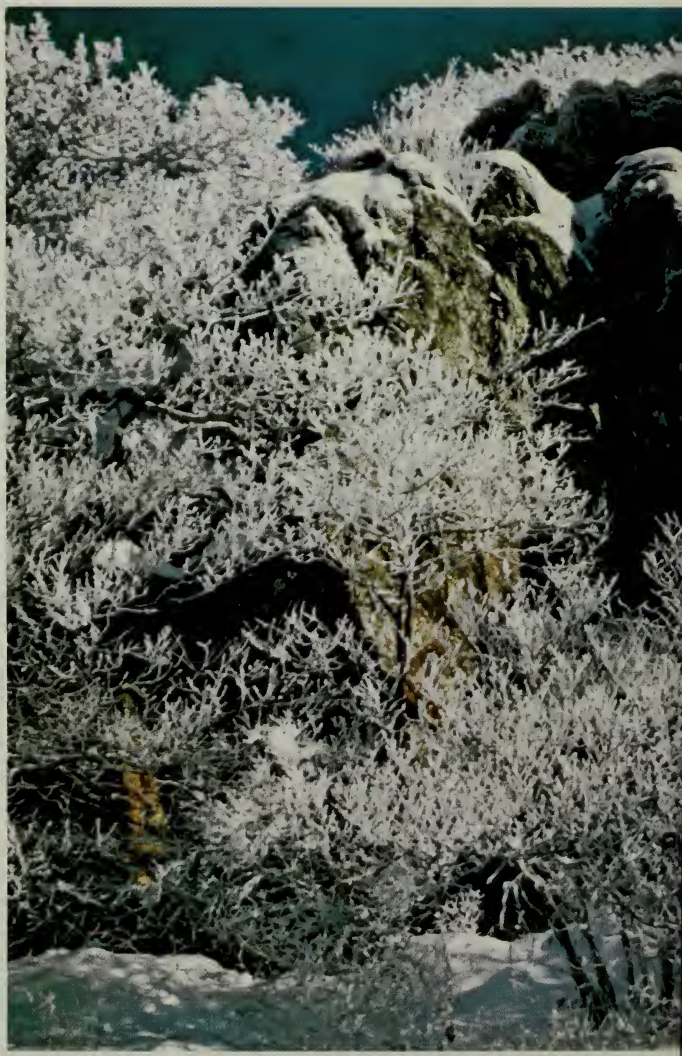
A Profile of a Mounta Stream in Shenandoah



If it's a hot day, one is tempted to submerge himself in one of the smooth-rock bathtubs provided by Big Run. There are nice ones near the fire road bridge. If you plan to explore downstream from here, you might appreciate a dip, because the pathless trip can be hard work. In its last mile or two in the park, Big Run winds through a narrow cut in the mountains known as The Portal. This is a scenic, rough stretch—well shaded, rock-walled, with bass and sunfish now joining the fish population. Once through The Portal, however, Big Run seems to decide that life in the level lowlands is not worth it, and sinks abrubtly into its gravelly bed. Thus ends one of the park's most life-filled streams.

Though never heavily settled, the Big Run basin suffered repeated burning and much hunting and trapping in pre-park days. But now those wounds are healed. Except for rock slides and stream openings, the forest is unbroken. Deer, bear, and turkey have returned in abundance. From high vistas one looks down upon a wild, wide-yawning basin revealing no scars from man's disruptive presence. It is easy to understand why Shenandoah-lovers reserve a place in their hearts for Big Run.





Summer is the biological peak of the Shenandoah year. Plants make food and the great pyramid of animal life dependent on them does most of its reproducing in this green season. Humans, too, are most abundant in the park during this vacation season. But the climax of the yearly story has little meaning apart from its beginning and its end. And it gives not a hint of the different beauty preceding and following it.

Come during the mid-winter sleep and you may find a world of dazzling beauty. In winter, the clearest season, the ridges north, south, and west often stand sharply etched against a blue sky. Geologic and forest patterns are more easily seen. On the heights, a foot or two of snow may cover the ground; and you may, if especially lucky, arrive on one of those few days when ice coats every branch, sparkling in the sun like a million diamonds.

But winter, of course, can also be severe. Temperatures on the ridge may be near zero, with bitter winds sweeping up the west slopes. Snowstorms may temporarily close Skyline Drive; but sections are cleared within a few days, so try the Drive in the winter for crystal views on clear days. If you're a

hardy soul, bundle up for an invigorating hike. There is life as well as scenery to be seen.

At first glance, the forest may seem empty, with nothing stirring and no sounds heard except the wind and the crunching of your feet on the snow. This is a realistic appraisal, but actually a great deal of life is here—sleeping, as it were. Trees and shrubs maintain themselves with food made in their leaves during summer and stored in roots and stems. Many perennials whose upper parts die survive the winter with underground roots. Under bark and within wood, eggs and larvae of billions of insects escape the cold winds of winter, while some species, such as the mourning cloak butterfly, winter in the adult stage, by hibernating. Part of the mammal population is sleeping, too. Chipmunks and woodchucks doze in their burrows, though warm weather can bring them out for a while. Bears in Shenandoah seem to sleep away the periods of severe weather, but forage during milder spells. Some of the park's bats avoid winter by migrating south; others, such as the common little brown bat, stay put, hibernating in hollow trees and in buildings.

Though it is hard to detect beneath the ice and snow, there is activity in streams, where the temperature, of course, is above freezing. Crayfish and insect larvae sift through bottom debris for food, while fish hunt plantlife, invertebrates, or smaller fish. Stream-inhabiting salamanders remain active in their moderate environment, but frogs must retire for the winter, hibernating in mud.

Even though most animal life is out of sight, you will have furred and feathered company on your winter hike. Deer and squirrels can be seen more easily in the leafless woods, and patterns in the snow reveal that bears, bobcats, raccoons, foxes, 'possums, or skunks have passed your way. Inspecting more closely, you will no doubt see where a little white-footed or deer mouse has pitter-pattered from one clump of vegetation to another.

Birds will be the most visible creatures. Many of the park's birds migrate south for the winter, but a sizeable contingent remains. You will probably meet a band or two of chickadees, titmice, nuthatches, and woodpeckers, which all forage together at this time of year, inspecting crevices and drilling into wood for insect eggs and larvae. Though they all seek the same general kind of food, there is specialization among them. Nuthatches work on tree trunks and larger limbs, chickadees and titmice on smaller branches—the acrobatic chickadees often feeding upside down on the under surfaces of the branches. Woodpeckers, too, divide their hunting area, the

larger species drilling into the thicker parts of trees while the downy woodpecker spends more time on small stems. One advantage of this mixed flocking may be that many eyes can spot predators more quickly: Cooper's and sharp-shinned hawks are a constant threat to small birds.

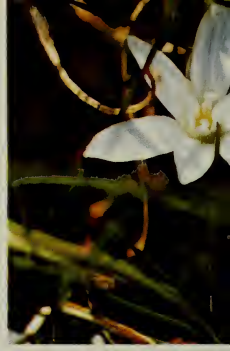
Most of the other common winter birds eat seeds or berries. In the more open areas you may find cardinals, juncos, goldfinches, and song, tree, and white-throated sparrows. And perhaps a flock of robins or cedar waxwings will appear. Most exciting is the sudden burst of a ruffed grouse flushed from the trailside, or the dark forms of turkeys trotting up a slope.

Perhaps because they are so few, we doubly enjoy the winter animals.

Who knows when spring begins in Shenandoah? For some, it is the swelling of red maple buds; for others, the first hepatica blossom peaking through dead leaves; for still others, the first mourning cloak butterfly flitting through snow-patched woods. Park people living at Big Meadows, however, listen for two special sounds. One is the quacking of wood frogs in Big Meadows swamp, and the other is the nasal beeping of woodcocks, which signals that these droll birds with the big eyes and long bills have returned from lands farther south and are starting their courtship flights.

All these events usually take place in March. Though they herald a new season, the mountain aspect is still decidedly wintry. By May, a green wave has begun to wash up the slopes. When it starts, icicles may still be hanging from the face of Stony Man, and oak buds on the ridges are still tightly closed. But as the upper elevations warm, winter gray gives way to spring green, some say at the rate of 100 feet of elevation a day. By early June, even the mountaintop oaks have reluctantly unfurled, and the Blue Ridge once again is fully clothed.

Leafing of the forest trees is a profoundly important event, for it provides new food for a myriad of animal forms, and it changes conditions on the forest floor. Most forest wildflowers do their blooming and photosynthesizing of food, using the sun's energy while it still reaches their leaves, during April and May, before the foliage of the canopy trees intercepts most of the sunlight. At this time bloodroot, spring beauty, toothwort, bluet, trillium, and a host of other wildflowers spangle the ground, and at the lower elevations, redbud and dogwood enliven the forest understory. Tree leafing has a positive effect on emerging insects, supplying them with an abundance of food. And they, in turn, feed the thousands of returning birds.



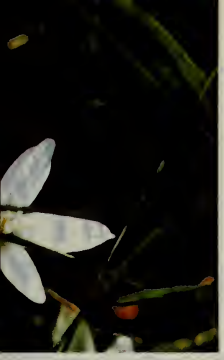
The migrant flocks contain many species that settle in Shenandoah and also many that require more northerly climes. Though at least 18 species of warblers breed in the park, several members of this brightly colored clan continue farther, some to the limit of tree growth in Canada. Water birds, headed for northern marshes or tundra, occasionally put down in the park. One foggy morning, Park Naturalist John Davis found a dunlin (red-backed sandpiper) resting on the grass at Thornton Gap, a long way from the nearest beach or mudflat.

As the warming spring air gradually seeps into burrows, logs, and dens, it wakes not only dormant mammals but also hibernating snakes. Generally the smaller species, such as ring-necked and garter snakes, come out first. By May or June, rattlesnakes and copperheads have emerged from the rocky dens, where they have wintered in large groups, to spread out over the surrounding terrain.

Shenandoah's streams become most exuberant in spring. Full to the brim, they shout and tumble down the mountainsides and make photographers happy. The life within them is exuberant, too, as aquatic insects transform into winged adults, to mate, lay eggs, and feed leaping trout. Many of the amphibians follow suit, laying their eggs in streams and temporary pools. Trilling of toads, peeping of spring peepers, and snoring of pickerel frogs are the sounds of males advertising for females. Salamanders, while quiet about it, seem to have no trouble finding each other.

Paradoxically, spring, when moisture seems abundant, is the park's worst season for fires. With snow gone, temperatures rising, many dead leaves on the ground, and new foliage not yet out, conditions are right for fires. When the ridgetop oaks fully open the palms of their leaves, thus signaling the beginning of summer, park fire-fighters no doubt breathe a little easier.

Ah, summer! Perhaps in no other season do lowlanders appreciate Shenandoah more, for that is when hot, humid air settles over the coastal strip for days at a time. A drive to the Blue Ridge leaves much of that behind, refreshes the spirit, and reminds one that there are purer parts of the world. Though afternoon thunderstorms often drench the mountains, extended rains are



rare. It's a pleasant season for walking, especially on the shadier eastern slopes.

Summer is decidedly a family time in the park, and not only for humans. Birds are raising young, swarms of tadpoles are growing toward froghood, eggs of box turtles and snakes are hatching in the warm soil, and insects are making their annual effort to inherit the earth.

A majority of mammal young have been born earlier, in the spring, and now, under parental tutelage, grow slowly toward maturity and independence. Bear cubs, born in dens very early in spring, now follow their mothers with agility and learn about ants in logs and a thousand other bear-food sources. Spotted fawns, born in May or June, lie concealed where their mothers left them, and later discover that leaves and buds taste as good as mother's milk. The young deer will stay with their mothers until the following winter, and the cubs until the next summer. But the young of smaller mammals mature faster, the period of dependency more or less shortening as size of animals decreases. Most of the smaller mammals have one litter a year, but mice and shrews may raise three or four. The prolific cottontail rabbit is even busier, sometimes producing five sets of young in a year.

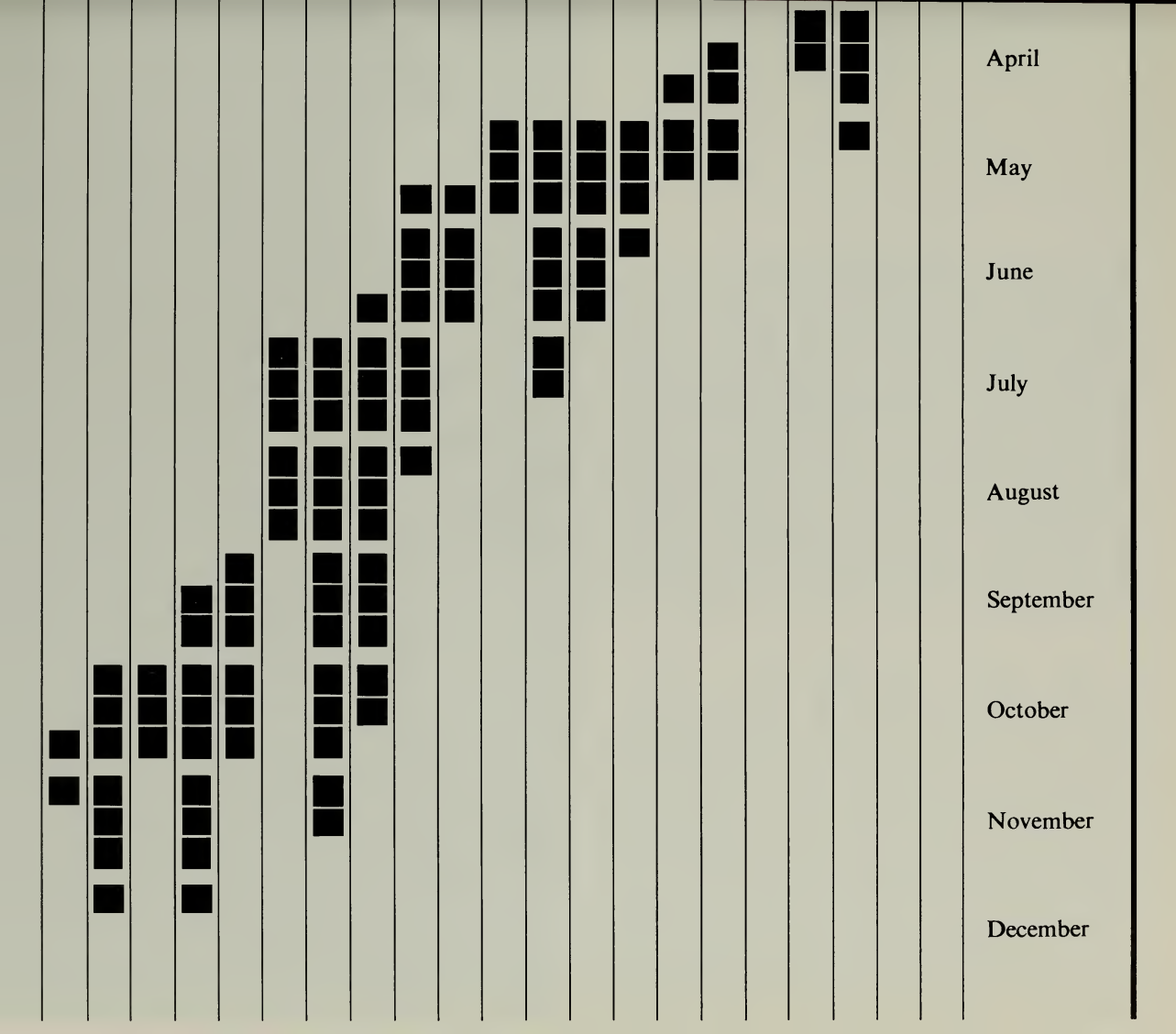
During the three summer months, our attention is drawn from one part of the natural drama to another. June is filled with bird song, as males proclaim their territories, and mountain laurel and azalea brighten much of the forest. Moist, rocky roadsides along the Drive begin their summer show with blossoms of goatsbeard, trumpet honeysuckle, wild hydrangea, New Jersey tea, thimbleberry, and other plants. Big Meadows has an interesting assortment, too, with plants more tolerant of open sunlight. Down in the grass, wild strawberries now offer their delicious fruit, while several species of lilies bloom conspicuously.

Bird song fades in the last half of July, as young birds are on the wing and wandering. Now begins the late-summer spectacle of asters, Joe-Pye-weed, and other composites. Just as characteristic of this time are the monotonous rasping calls of false katydids and cicadas; and from now into the fall, grasshoppers in profusion hop through the grass. By late August, a few migrating birds have ap-

Selected Seasonal Events

The events listed below occur, under typical conditions, during the months (divided into 10-day periods) indicated.

Bear cubs born in dens
Woodchucks end hibernation
Hepaticas bloom
Wood frogs breed
Woodcocks return to Big Meadows
Main period, spring bird migration
Dogwoods bloom
Tree leafing at Big Meadows
Deer fawns born
Main period, bird nesting
Trilliums bloom
Mountain laurels bloom
Milkweeds bloom
Goldenrods bloom
Asters bloom
Cicadas calling
Main period, fall bird migration
Witchhazels bloom
Main period, fall color
Deer rut
Brook trout spawn


April
May
June
July
August
September
October
November
December

peared and some leaves of black gum and Virginia creeper have turned red, giving advance notice of the autumn blaze to come.

In many ways, fall is the reverse of spring. The insects, mammals, and snakes that emerge latest in spring are usually the earliest to disappear in fall. Many late-migrating spring birds return on their southward trip early in fall. Autumn colors first appear on the ridgetops and then creep downward.

Bird migration occurs mainly in September and early October as warblers, vireos, thrushes, flycatchers, and other small birds stream south along the ridges by night and feed and rest by day. They seem to be much more abundant in the Blue Ridge in fall than in spring, perhaps mainly because leaves are not far out at high elevations during the spring migration. Traveling by day, hawks drift along the ridges on west or northwest winds. The top of Big Flat Mountain (site of the Loft Mountain campground) and Marys Rock (south of Thornton Gap) are good spots from which to watch this exciting spectacle. Be sure winds are propitious or you may draw a blank on hawks. Most spectacular are occasional heavy flights of broad-winged hawks in mid- or late September.

Though spots of color have been slowly increasing since August, the major show comes in

October. The blaze seems to begin on ridges and dry southwest slopes, marked by the yellows of chestnut oak and hickory. The conflagration is soon intensified with the purple of ashes and red of red maples, and reaches its peak—usually in mid-October —when the yellows of striped and mountain maples, birches, and tulip trees, and the reds of white and red oaks join in. In case you need an explanation for all this beauty, scientists have a partial one. Loss of green chlorophyll during the lengthening nights has revealed the yellow pigments that are always present in some species, and warm days and cool but not freezing nights have encouraged production of the red and purple pigments in others.

By November, few insects are about; most have been killed or sent into hibernation by frosts. The trees have lost most of their leaves. Reptiles and amphibians have gone underground to maintain acceptable body temperatures. A few robins and blue jays are still straggling southward, but birds are now scarce. Perhaps a bald or a golden eagle will pause for a few days and then depart in search of better hunting grounds. A final burst of reproductive activity occurs as trout spawn in gravelly pools and bucks fight for does. One day, snow falls in earnest. The quiet of winter returns.

The Future

In its long history, the Blue Ridge area has changed many times, and no doubt it will change many more. It has been barren mountains, part of a broad plateau, and under the sea; and it has bulged up again into a mighty range, only to wear down while trees covered its slopes and life continued to evolve.

Even in the past 40 years, the Shenandoah landscape has changed markedly. The many open fields and pastures have been reclaimed by forest, forcing animal life to adjust accordingly. This has diminished open-country animals such as red foxes, woodchucks, bobwhites, and rabbits, and encouraged bears, pileated woodpeckers, and other forest animals.

What changes can we expect in the next 40 years? Within the park, probably there will be no changes as dramatic as those experienced since the thirties. Trees will grow somewhat taller, and many of the locusts, pines, sassafras, and other pioneers will give way to the more shade-tolerant

oaks, hickories, ashes, tulip trees, and others. Ridgetop forests will remain stunted as the elements buffet them, but trees in hollows will continue toward their giant potential. Some forest creatures will probably increase. Woodpeckers, for instance, will benefit as the aging forest produces more insect-infested wood. But animal populations in general will probably decline somewhat as the closing canopy shades out vegetation near the forest floor.

Taking a geological perspective, we can imagine all sorts of possibilities. The Blue Ridge may erode to virtually nothing and be covered again by water. Or it may be pressured upward into craggy peaks. Perhaps there is a long chance that lava will once again flow from great cracks in the rock. And changing climate may put entirely different vegetative clothes on the land. A warming trend could once again bring tropical forests, or cooling could bring glaciers from the north—perhaps this time to bury the Blue Ridge and wipe its biological slate clean. And who knows what new forms of life will evolve in response to the ever-changing environments?

But our concern and responsibility involve the next few generations. What sort of Shenandoah and eastern seaboard will we leave them? Will megalopolitan sprawl surround the Blue Ridge with housing tracts, choke its air with pollutants, and fill every trail with people? Or will we protect our environment, carefully channel our development, and stop our population growth? Our choices may well determine whether the natural drama of today will continue into the next century and the next.

We will have to make some hard choices and sacrifices to keep these: deer grazing at dusk in Big Meadows, clear water tumbling over ancient gray boulders, a bear leading cubs through shadowy, unbroken forest, a raven gliding high above the wilderness of Shenandoah.

Appendix

Habitats of Shenandoah National Park

The classification of park habitats used in the plant and bird checklists was developed by Charles E. Stevens of Charlottesville, Va. Descriptions of the habitats are:

1 *Oak, oak-hickory forest*—principally red, white, and chestnut oak, with a sprinkling of several species of hickory, white ash, red maple, and a few other deciduous species. Occurs on slopes and the moister ridges. Principal forest type in the park.

2 *Cove hardwoods*—a mixture of many deciduous trees—particularly yellow-poplar ("tuliptree"), red and white oak, basswood, sugar maple (in some hollows), and black and yellow birch—often accompanied by hemlock. Occurs in moist hollows.

3 *Hemlock, hemlock-white pine groves*—composed largely of these species, with little ground vegetation. Occurs in cool, moist areas, often at the heads of hollows. Limberlost is the prime example.

4 *Oak-pine forest*—mainly scarlet and chestnut oak and pitch pine in open stands, with dense shrub layer of scrub oak and mountain-laurel and other "heath" species. Southwest slopes and dry ridges.

5 *Birch-maple forest*—principally yellow and black birch, red oak, and basswood, with understory of striped and mountain maple, witch-hazel, red-berried elder, and other species. Occurs in cool, moist, rocky areas, generally at high elevations. Example: north face of Hawksbill Mountain.

6 *Wooded streams, stream margins, boggy places*—includes all the park's wet environments, except for type 9. Streams run mostly through forest types; at lower elevations often bordered by common alder. A few boggy spots around springs are open, with herbaceous vegetation.

7 *Open fields, road shoulders*—grasses, sedges, and other herbaceous plants, with scattering of shrubs and small trees. Few of these areas left; now mainly Big Meadows, Patterson's Field, and along Skyline Drive.

8 *Shrubby abandoned fields*—later stage of type 7, with blackberry, hawthorn, pitch and scrub pine, and other woody pioneer species. Example: Milam Gap.

9 *Shrub swamp*—principally Big Meadows Swamp, where common alder, grey birch, and hawthorn are the main woody species.

10 *Open cliffs and rock outcrops*—scattered about park. Includes road cuts where rocky.

11 *Shaded cliffs and rock outcrops*—scattered about park.

Ferns and Fern Allies

This list of park ferns is taken from Peter Mazzeo's *"Ferns and Fern Allies of Shenandoah National Park."*

Habitat symbols: 1 oak, oak-hickory forest; **2** cove hardwoods; **3** hemlock, hemlock-white pine groves; **4** oak-pine forest; **5** birch-maple forest; **6** wooded streams, stream margins, boggy places; **7** fields, road shoulders; **8** shrubby abandoned fields; **9** shrub swamp; **10** open cliffs, rock outcrops; **11** shaded cliffs, rock outcrops
Occurrence symbols: C common; **U** uncommon; **R** rare

Common Name	*Scientific Name*	*Habitats*	*Occurrence*
Common Horsetail	*Equisetum arvense*	**7**	**U**
Mountain Club-moss	*Lycopodium selago*	**11**	**R**
Fir Club-moss	*L. selago* var. *patens*	**11**	**U**
Shining Club-moss	*L. lucidulum*	**2, 3**	**U**
Common Club-moss	*L. clavatum*	**8**	**R**
Round-branched Groundpine	*L. obscurum var. dendroideum*	**4**	**U**
Running Pine	*L. flabelliforme*	**1, 3, 4, 5, 8**	**C**
Ground-cedar	*L. tristachyum*	**4, 8**	**U**
Spikemoss	*Selaginella rupestris*	**10**	**U**
Quillwort	*Isoetes virginica*	**9**	**R**
Leathery Grape-fern	*Botrychium multifidum*	**8**	**R**
Blunt-lobed Grape-fern	*B. oneidense*	**2, 5**	**U**
Cutleaf Grape-fern	*B. dissectum*	**1, 8**	**U**
Oblique Grape-fern	*B. dissectum* f. *obliquum*	**1, 8**	**C**
Triangle Grape-fern	*B. matricariaefolium*	**2, 5**	**U**
Daisy-leaf Grape-fern	*B. lanceolatum var. angustisegmentum*	**5**	**R**
Rattlesnake-fern	*B. virginianum*	**2**	**C**

Common Name	*Scientific Name*	*Habitats*	*Occurrence*
Royal Fern	*Osmunda regalis*	**6, 9**	**U**
Interrupted Fern	*O. claytoniana*	**1, 2, 5, 6**	**C**
Cinnamon Fern	*O. cinnamonea*	**6, 9**	**C**
Rusty Woodsia	*Woodsia ilvensis*	**10**	**R**
Blunt-lobed Woodsia	*W. obtusa*	**8, 10, 11**	**C**
Fragile Fern	*Cystopteris fragilis*	**11**	**U**
Sensitive Fern	*Onoclea sensibilis*	**6, 9**	**C**
Woodland Oak Fern	*Thelypteris dryopteris*	**5, 11**	**U**
Marsh Fern	*T. palustris*	**6, 9**	**U**
New York Fern	*T. noveboracensis*	**2, 3, 6**	**C**
Broad Beech Fern	*T. hexagonoptera*	**2**	**C**
Spinulose Wood-fern	*Dryopteris spinulosa* *D. intermedia*	**6** **2, 3,5, 11**	**U** **C**
Marginal Shield-fern	*D. marginalis*	**1, 2, 3, 5, 11**	**C**
Christmas Fern	*Polystichum acrostichoides*	**1, 2, 3, 11**	**C**
Hay-scented Fern	*Dennstaedtia punctilobula*	**1, 5, 7, 8, 11**	**C**
Silvery Spleenwort	*Athyrium thelypterioides*	**2**	**U**
Lady Fern	*A. filix-femina* var. *asplenioides* (*A. asplenioides* A. Eaton)	**2, 6**	**C**
Walking Fern	*Camptosorus rhizophyllus*	**11**	**U**
Pinnatifid Spleenwort	*Asplenium pinnatifidum*	**11**	**R**
Mountain Spleenwort	*A. montanum*	**11**	**U**
Bradley's Spleenwort	*A. bradleyi*	**11**	**R**
Blackstem Spleenwort	*A. resiliens*	**11**	**R**
Maidenhair Spleenwort	*A. trichomanes*	**11**	**U**
Ebony Spleenwort	*A. platyneuron*	**8, 10, 11**	**C**

Common Name	*Scientific Name*	*Habitats*	*Occurrence*
Hairy Lip-fern	*Cheilanthes lanosa*	**10**	**U**
Maidenhair Fern	*Adiantum pedatum*	**2**	**C**
Bracken Fern	*Pteridium aquilinum*	**4, 8**	**C**
Common Polypody	*Polypodium virginianum*	**11**	**C**

Herbaceous Flowering Plants

The following list, provided by Charles E. Stevens, consists of 201 of the more common and/or interesting herbaceous flowering plants of the park. Most common and all scientific names follow Gray's *Manual of the Botany of the Northern United States,* 8th Edition, 1950.

Habitat symbols: 1 oak, oak-hickory forest; **2** cove hardwoods; **3** hemlock, hemlock-white pine groves; **4** oak-pine forest; **5** birch-maple forest; **6** wooded streams, stream margins, boggy places; **7** fields, road shoulders; **8** shrubby abandoned fields; **9** shrub swamp; **10** open cliffs, rock outcrops; **11** shaded cliffs, rock outcrops

Common Name	*Scientific Name*	*Habitats*
Brome-grass	*Bromus purgans*	**1, 2, 11**
Orchard-grass	*Dactylis glomerata*	**7**
Poverty-grass	*Danthonia spicata*	**1, 7, 8, 10**
Bottle-brush Grass	*Hystrix patula*	**1, 5, 11**
Wiregrass	*Poa compressa*	**1, 7, 8, 10**
"	*P. cuspidata*	**1, 2, 11**
Sedge	*Carex aestivalis*	**5, 11**
"	*C. pensylvanica*	**1, 5, 7, 10, 11**
"	*C. platyphylla*	**1, 2, 3 ,11**
"	*C. torta*	**6**
Bulrush	*Scirpus cyperinus*	**6, 9**
Jack-in-the-Pulpit	*Arisaema triphyllum*	**2**

Common Name	*Scientific Name*	*Habitats*
Skunk-cabbage	*Symplocarpus foetidus*	**6, 9**
Virginia Spiderwort	*Tradescantia virginiana*	**5, 11**
Wild Onion	*Allium cernuum*	**10, 11**
Fly-poison	*Amianthium muscaetoxicum*	**1, 4, 11**
Bluebead-lily	*Clintonia borealis*	**5**
Speckled Wood-lily	*C. umbellulata*	**3, 5, 11**
Yellow Adder's-tongue	*Erythronium americanum*	**2**
Turk's-cap Lily	*Lilium superbum*	**2, 6, 11**
Wild Lily-of-the-valley	*Maianthemum canadense*	**3, 5, 11**
Indian Cucumber-root	*Medeola virginiana*	**1, 2, 3,**
Bunchflower	*Melanthium parviflorum*	**2, 3, 5**
Solomon's-seal	*Polygonatum biflorum*	**1, 2, 11**
False Spikenard	*Smilacina racemosa*	**1, 2, 11**
Sawbrier	*Smilax glauca*	**1, 6, 8**
Featherbells	*Stenanthium gramineum*	**1, 4, 11**
Erect Trillium	*Trillium erectum*	**2, 3, 5**
Large-flowered Trillium	*T. grandiflorum*	**2, 5**
Painted Trillium	*T. undulatum*	**3**
Perfoliate Bellwort	*Uvularia perfoliata*	**2**
Sessile Bellwort	*U. sessilifolia*	**1, 2**
White Hellebore	*Veratrum viride*	**6, 9**
Turkeybeard	*Xerophyllum asphodeloides*	**4**
Yam	*Dioscorea quaternata*	**1, 2, 3**
Hairy Stargrass	*Hypoxis hirsuta*	**1, 8**

Common Name	*Scientific Name*	*Habitats*
Dwarf Iris	*Iris verna*	**1, 4**
Narrow-leaved Blue-eyed Grass	*Sisyrinchium angustifolium*	**1, 8**
Putty-root	*Aplectrum hyemale*	**2**
Spotted Coral-root	*Corallorhiza maculata*	**1, 2, 3**
Late Coral-root	*C. odontorhiza*	**1, 2, 3**
Stemless Lady's-slipper	*Cypripedium acaule*	**1, 3, 4**
Yellow Lady's-slipper	*C. calceolus*	**1, 2**
Downy Rattlesnake-plantain	*Goodyera pubescens*	**1, 2, 3**
Green Woodland Orchis	*Habenaria clavellata*	**6**
Small Purple-fringed Orchis	*H. psycodes*	**6**
Whorled Pogonia	*Isotria verticillata*	**1, 4**
Lily-leaved Twayblade	*Liparis lilifolia*	**1**
Showy Orchis	*Orchis spectabilis*	**2**
Nodding Ladies'-tresses	*Spiranthes cernua*	**6, 8**
Canada Wild Ginger	*Asarum canadense*	**2**
Virginia Heartleaf	*A. virginicum*	**1**
Deptford Pink	*Dianthus armeria*	**7, 8**
White Campion	*Lynchnis alba*	**7, 8**
Bouncing-bet	*Saponaria officinalis*	**7, 8**
Carolina Catchfly	*Silene caroliniana*	**10**
Starry Campion	*S. stellata*	**1, 2, 11**
Great Chickweed	*Stellaria pubera*	**1, 2, 3, 11**
Spring-beauty	*Claytonia virginica*	**2**
White Baneberry	*Actaea pachypoda*	**2, 3**

Common Name	*Scientific Name*	*Habitats*
Wood Anemone	*Anemone quinquefolia*	**2, 6**
Thimbleweed	*A. virginiana*	**1, 8**
Rue Anemone	*Anemonella thalictroides*	**1, 2, 3**
Wild Columbine	*Aquilegia canadensis*	**1, 11**
Marsh-marigold	*Caltha palustris*	**6, 9**
Black Snakeroot	*Cimicifuga racemosa*	**1, 2**
Virgin's-bower	*Clematis virginiana*	**1, 8**
Round-lobed Liverleaf	*Hepatica americana*	**1, 2, 3**
Kidneyleaf Buttercup	*Ranunculus abortivus*	**1, 6**
Bulbous Buttercup	*R. bulbosus*	**7**
Early Meadow-rue	*Thalictrum dioicum*	**1, 2, 6**
Blue Cohosh	*Caulophyllum thalictroides*	**2**
May-apple	*Podophyllum peltatum*	**1, 2**
Poppy	*Papaver dubium*	**7**
Bloodroot	*Sanguinaria canadensis*	**1, 2**
Pale Corydalis	*Corydalis sempervirens*	**10**
Dutchman's-breeches	*Dicentra cucullaria*	**2**
Turkey-corn	*D. eximia*	**11**
Rock-cress	*Arabis laevigata*	**1, 2, 10, 11**
Early Winter-cress	*Barbarea verna*	**7, 8**
Shepherd's Purse	*Capsella bursa-pastoris*	**7, 8**
Bitter Cress	*Cardamine hirsuta*	**7, 8**
Cutleaf Toothwort	*Dentaria laciniata*	**1, 2, 3**
Cow-cress	*Lepidium campestre*	**7, 8**

Common Name	*Scientific Name*	*Habitats*
Field Penny-cress	*Thlaspi arvense*	**7, 8**
Stonecrop	*Sedum ternatum*	**1, 2, 11**
Allegheny Stonecrop	*S. telephioides*	**10**
Alumroot	*Heuchera americana*	**10, 11**
Miterwort	*Mitella diphylla*	**2, 6**
Michaux's Saxifrage	*Saxifraga michauxii*	**10**
Lettuce Saxifrage	*S. micranthidifolia*	**6**
Early Saxifrage	*S. virginiensis*	**10, 11**
Goat's-beard	*Aruncus dioicus*	**1, 2, 5, 11**
Wild Strawberry	*Fragaria virginiana*	**7, 8**
Bowman's-root	*Gillenia trifoliata*	**1**
Wild Indigo	*Baptisia tinctoria*	**4**
Wild Sensitive Plant	*Cassia nictitans*	**7, 8**
Naked-flowered Tick-trefoil	*Desmodium nudiflorum*	**1**
Wild Lupine	*Lupinus perennis*	**1**
Goat's-rue	*Tephrosia virginiana*	**1, 4**
Red Clover	*Trifolium pratense*	**7**
Wood-vetch	*Vicia caroliniana*	**1, 8**
Common Wood-sorrel	*Oxalis montana*	**3**
Violet Wood-sorrel	*O. violacea*	**1, 2**
Carolina Wild Geranium	*Geranium carolinianum*	**7, 8**
Wild Geranium	*G. maculatum*	**1, 2**
Flowering Spurge	*Euphorbia corollata*	**8, 10**
Climbing Bittersweet	*Celastrus scandens*	**8**

Common Name	*Scientific Name*	*Habitats*
Spotted Touch-me-not	*Impatiens capensis*	**1, 2, 3, 6**
Virginia Creeper	*Parthenocissus quinquefolia*	**1, 8, 10**
Canada Violet	*Viola canadensis*	**2**
Marsh Blue Violet	*V. cucullata*	**6**
Northern Downy Violet	*V. fimbriatula*	**7, 8**
Field-pansy	*V. kitaebeliana*	**7, 8**
Common Blue Violet	*V. papilionacea*	**1, 2, 7, 8**
Birdfoot Violet	*V. pedata*	**1, 4**
Smooth Yellow Violet	*V. pensylvanica*	**1, 2**
Fireweed	*Epilobium angustifolium*	**8, 10**
Evening-primrose	*Oenothera biennis*	**7, 8**
Wild Sarsaparilla	*Aralia nuducaulis*	**1, 3, 4, 5**
Spotted Cowbane	*Cicuta maculata*	**6, 9**
Lovage	*Ligusticum canadense*	**1, 2, 3**
Sweet Cicely	*Osmorhiza claytoni*	**2**
Black Snakeroot	*Sanicula canadensis*	**1, 2**
Meadow-parsnip	*Thaspium barbinode*	**1**
Meadow-parsnip	*T. trifoliatum*	**1**
Spotted Wintergreen	*Chimaphila maculata*	**1, 3, 4**
Trailing Arbutus	*Epigaea repens*	**1, 4**
Teaberry	*Gaultheria procumbens*	**1, 4**
Whorled Loosestrife	*Lysimachia quadrifolia*	**1, 3, 4**
Star-flower	*Trientalis borealis*	**3, 5**
Stiff Gentian	*Gentiana quinquefolia*	**7, 8**

Common Name	*Scientific Name*	*Habitats*
Pennywort	*Obolaria virginica*	**2**
Indian Hemp	*Apocynum cannabinum*	**7, 8**
Butterfly-weed	*Asclepias tuberosa*	**7, 8, 10**
Moss-phlox	*Phlox subulata*	**10**
Waterleaf	*Hydrophyllum virginianum*	**1, 2**
Viper's Bugloss	*Echium vulgare*	**7, 8**
Horse-balm	*Collinsonia canadensis*	**2, 6**
Wild Bergamot	*Monarda fistulosa*	**7, 8**
Mountain-mint	*Pycnanthemum incanum*	**1, 8**
Skullcap	*Scutellaria integrifolia*	**2**
White Turtlehead	*Chelone glabra*	**6**
Smooth Gerardia	*Gerardia laevigata*	**1, 3**
Butter-and-eggs	*Linaria vulgaris*	**7, 8**
Cow-wheat	*Melampyrum lineare*	**4**
Common Lousewort	*Pedicularis canadensis*	**1, 3, 8**
Beard-tongue	*Penstemon canescens*	**8, 10**
Hairy Beard-tongue	*P. hirsutus*	**8, 10**
Figwort	*Scrophularia marilandica*	**1, 2, 8**
Common Speedwell	*Veronica officinalis*	**1, 7, 8**
Cleavers	*Galium aparine*	**1, 2, 8**
Broad-leaved Bedstraw	*G. latifolium*	**1**
Bluets	*Houstonia caerulea*	**1, 3, 8**
Long-leaved Bluets	*H. longifolia*	**1, 9**
Partridge-berry	*Mitchella repens*	**1, 3, 11**

Common Name	*Scientific Name*	*Habitats*
Japanese Honeysuckle	*Lonicera japonica*	**1, 2, 8**
Southern Harebell	*Campanula divaricata*	**1, 5, 10, 11**
Venus's Looking-glass	*Specularia perfoliata*	**7, 8**
Cardinal-flower	*Lobelia cardinalis*	**6**
Common Yarrow	*Achillea millefolium*	**7, 8**
Wing-stem	*Actinomeris alternifolia*	**6, 8**
Common Ragweed	*Ambrosia artemisiifolia*	**7, 8**
Plantain-leaved Pussy's-toes	*Antennaria plantaginifolia*	**7, 8, 10**
Whorled Wood Aster	*Aster acuminatus*	**3, 5, 6**
White Wood Aster	*A. divaricatus*	**1, 2, 3, 5, 11**
Smooth Aster	*A. laevis*	**1**
Late Purple Aster	*A. patens*	**1, 7, 8**
Spanish Needles	*Bidens bipinnata*	**8**
Spotted Star-thistle	*Centaurea maculosa*	**7, 8**
Chrysogonum	*Chrysogonum virginianum*	**1**
Whorled Coreopsis	*Coreopsis verticillata*	**1, 4, 10**
Pilewort	*Erechtites hieracifolia*	**1, 7, 8**
Horseweed	*Erigeron canadensis*	**7, 8**
Joe-pye-weed	*Eupatorium fistulosum*	**6**
Boneset	*E. perfoliatum*	**6, 9**
Purple Joe-pye weed	*E. purpureum*	**1, 2**
White Snakeroot	*E. rugosum*	**1, 2, 8**
Catfoot	*Gnaphalium obtusifolium*	**7, 8**
Woodland Sunflower	*Helianthus divaricatus*	**8, 10**

Common Name	*Scientific Name*	*Habitats*
Ox-eye	*Heliopsis helianthoides*	**1, 2, 8**
Rattlesnake-weed	*Hieracium venosum*	**1, 4**
Wild Lettuce	*Lactuca canadensis*	**1, 8**
Blazing-star	*Liatris graminifolia*	**7, 8, 10**
Wild Quinine	*Parthenium integrifolium*	**7, 8, 10**
Small-flowered Leafcup	*Polymnia canadensis*	**2, 11**
White Lettuce	*Prenanthes alba*	**1**
Black-eyed Susan	*Rudbeckia hirta*	**7, 8**
Cutleaf Coneflower	*R. laciniata*	**6**
Cx-eye-daisy	*Chrysanthemum leucanthemum*	**7, 8**
Golden Ragwort	*Senecio aureus*	**6**
Smalls' Ragwort	*S. smallii*	**7, 8, 11**
White-topped Aster	*Sericocarpus asteroides*	**1, 4**
Tall Goldenrod	*Solidago altissima*	**7, 8**
White Goldenrod	*S. bicolor*	**1, 8**
Blue-stemmed Goldenrod	*S. caesia*	**1, 2, 3**
Erect Goldenrod	*S. erecta*	**1, 8**
Downy Goldenrod	*S. puberula*	**1, 8**
Rough-stemmed Goldenrod	*S. rugosa*	**8**
Common Dandelion	*Taraxacum officinale*	**7**
New York Ironweed	*Vernonia noveboracensis*	**6**

Trees and Shrubs

This list contains all the species of trees and shrubs reliably reported from the park as of November 1971. It excludes non-native species that are persisting at old homesites but have not become established in the wild. The list was supplied by Peter M. Mazzeo, of the

National Herbarium, and Charles E. Stevens, of Charlottesville, Virginia. Common names of trees conform to the Forest Service *Check List of Native and Naturalized Trees of the United States.* Most common names of shrubs follow George A. Petrides' *A Field Guide to Trees and Shrubs,* 1958. Scientific names follow Gray's *Manual of the Botany of the Northern United States,* 8th Edition, 1950.

Habitat symbols: 1 oak, oak-hickory forest; **2** cove hardwoods; **3** hemlock, hemlock-white pine groves; **4** oak-pine forest; **5** birch-maple forest; **6** wooded streams, stream margins, boggy places; **7** fields, road shoulders; **8** shrubby abandoned fields; **9** shrub swamp; **10** open cliffs, rock outcrops; **11** shaded cliffs, rock outcrops
Occurrence symbols: **C** common; **U** uncommon; **R** rare
Form symbols: **S** shrub; **T** tree

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
American Yew	*Taxus canadensis*	**3, 11**	**U**	**S**
Balsam Fir	*Abies balsamea*	**5, 11**	**U**	**T**
Eastern Hemlock	*Tsuga canadensis*	**1, 2, 3, 5, 6, 8, 11**	**C**	**T**
Red Spruce	*Picea rubens*	**3, 5, 11**	**U**	**T**
Eastern White Pine	*Pinus strobus*	**1, 2, 3, 5, 8, 10, 11**	**C**	**T**
Shortleaf Pine	*Pinus echinata*	**1**	**U**	**T**
Virginia ("Scrub") Pine	*P. virginiana*	**4, 7, 8**	**C**	**T**
Pitch Pine	*P. rigida*	**1, 4, 7, 8, 11**	**C**	**T**
Table-Mountain Pine	*P. pungens*	**1, 4, 7, 8, 11**	**C**	**T**
Eastern Redcedar	*Juniperus virginiana*	**7, 8, 10**	**C**	**T**
Black Willow	*Salix nigra*	**6**	**C**	**T** or **S**
Coastal Plain Willow	*S. caroliniana*	**2**	**U**	**T**
Prairie Willow	*S. humilis*	**7, 8, 10**	**C**	**S**
Silky Willow	*S. sericea*	**2, 6**	**U**	**S**
Quaking Aspen	*Populus tremuloides*	**1, 4**	**U**	**T**
Bigtooth Aspen	*P. grandidentata*	**1, 4, 10**	**U**	**T**

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
Eastern Cottonwood	*P. deltoides*	7	U	T
Sweet-fern	*Comptonia peregrina*	4, 8, 10	C	S
Butternut	*Juglans cinerea*	2	C	T
Black Walnut	*J. nigra*	2	U	T
Bitternut Hickory	*Carya cordiformis*	2	U	T
Shagbark Hickory	*C. ovata*	1, 2	C	T
Mockernut Hickory	*C. tomentosa*	1	C	T
Pignut Hickory	*C. glabra*	1, 2	C	T
*Sweet Pignut Hickory	*C. ovalis*	1, 2	C	T
American Hazelnut	*Corylus americana*	6, 8	C	S
Beaked Hazelnut	*C. cornuta*	1, 2	C	S
Eastern Hophornbeam	*Ostrya virginiana*	2, 5	C	T
American Hornbeam ("Ironwood")	*Carpinus caroliniana*	6	C	T
Sweet ("Black") Birch	*Betula lenta*	1, 2, 3, 5, 8, 10, 11	C C	T
Yellow Birch	*B. alleghaniensis* (*B. lutea*)	2, 3, 5, 6, 11	C	T
Gray Birch	*B. populifolia*	8, 9	C (locally)	T
Paper Birch	*B. papyrifera*	5, 11	U	T
Speckled Alder	*Alnus rugosa*	6	R	S
Hazel Alder	*A. serrulata*	6, 9	C	S
American Beech	*Fagus grandifolia*	2	U	T
American Chestnut	*Castanea dentata*	1, 4	C	T (sprouts)
Allegheny Chinquapin	*C. pumila*	1	U	S or T
White Oak	*Quercus alba*	1, 2	C	T

*Not recognized as a species in F.S. *Check List.*

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
Post Oak	*Q. stellata*	**1**	**U**	**T**
Chestnut Oak	*Q. prinus*	**1, 4, 10, 11**	**C**	**T**
Northern Red Oak	*Q. rubra*	**1, 2, 5, 11**	**C**	**T**
Scarlet Oak	*Q. coccinea*	**1, 4**	**C**	**T**
Black Oak	*Q. velutina*	**1**	**C**	**T**
Bear ("Scrub") Oak	*Q. ilicifolia*	**4, 10**	**C**	**S** or **T**
Blackjack Oak	*Q. marilandica*	**1, 4**	**U**	**T** or **S**
Shingle Oak	*Q. imbricaria*	**1**	**R**	**T**
American Elm	*Ulmus americana*	**2, 6**	**U**	**T**
Slippery Elm	*U. rubra*	**2, 6**	**U**	**T**
Hackberry	*Celtis occidentalis*	**6, 8, 10**	**U**	**S** or **T**
Red Mulberry	*Morus rubra*	**2, 8**	**C**	**T**
Umbrella Magnolia	*Magnolia tripetala*	**2**	**U**	**T**
Yellow-poplar ("Tuliptree")	*Liriodendron tulipifera*	**1, 2**	**C**	**T**
Sassafras	*Sassafras albidum*	**4, 7, 8**	**C**	**T**
Common Spicebush	*Lindera benzoin*	**2, 6**	**C**	**S**
Wild Hydrangea	*Hydrangea arborescens*	**1, 2, 5, 11**	**C**	**S**
Roundleaf Gooseberry	*Ribes rotundifolium*	**1, 5, 10, 11**	**C**	**S**
Witch-hazel	*Hamamelis virginiana*	**1, 2, 4, 5, 11**	**C**	**S** or **T**
American Sycamore	*Platanus occidentalis*	**6**	**C**	**T**
Ninebark	*Physocarpus opulifolius*	**5, 10, 11**	**C**	**S**
Broadleaf Spiraea	*Spiraea latifolia*	**9, 10**	**U**	**S**
Dwarf Spiraea	*S. corymbosa*	**1, 10, 11**	**C**	**S**
Common Apple	*Pyrus malus*	**7, 8**	**C**	**T**

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
American Crabapple	*P. coronaria*	**8**	**U**	**S** or **T**
Red Chokeberry	*P. arbutifolia*	**6**	**U**	**S** or **T**
Black Chokeberry	*P. melanocarpa*	**4, 10**	**C**	**S** or **T**
American Mountain-ash	*Sorbus americana*	**10**	**U**	**T** or **S**
Downy Serviceberry	*Amelanchier arborea*	**1, 4, 10**	**C**	**T** or **S**
Allegheny Serviceberry	*A. laevis*	**1, 8**	**U**	**T** or **S**
Hawthorn	*Crataegus* spp.	**7, 8**	**C**	**S** or **T**
Thimbleberry	*Rubus odoratus*	**5, 11**	**C**	**S**
Wine Raspberry	*R. phoenicolasius*	**8**	**U**	**S**
Black Raspberry	*R. occidentalis*	**6, 8**	**C**	**S**
Blackberry	*R. allegheniensis*	**6, 7, 8, 11**	**C**	**S**
Swamp Rose	*Rosa palustris*	**6, 9**	**U**	**S**
Carolina Rose	*R. carolina*	**8, 10**	**C**	**S**
American Plum	*Prunus americana*	**8**	**U**	**S** or **T**
Common Peach	*P. persica*	**7, 8**	**U**	**T**
Pin ("Fire") Cherry	*P. pensylvanica*	**4, 8**	**U**	**S** or **T**
Mazzard ("Sweet Cherry")	*P. avium*	**8**	**U**	**T**
Black Cherry	*P. serotina*	**1, 2, 8**	**C**	**T**
Common Chokecherry	*P. virginiana*	**1, 5, 11**	**C**	**S** or **T**
Eastern Redbud	*Cercis canadensis*	**2**	**C**	**T**
Black Locust	*Robinia pseudoacacia*	**1, 7, 8, 10**	**C**	**T**
Common Hoptree	*Ptelea trifoliata*	**2, 10**	**R**	**S** or **T**
Allanthus ("Tree-of-heaven")	*Ailanthus altissima*	**8**	**C**	**T**
Staghorn Sumac	*Rhus typhina*	**7, 8**	**C**	**S** or **T**

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
Smooth Sumac	*R. glabra*	**7, 8**	**C**	**S** or **T**
Shining ("Winged") Sumac	*R. copallina*	**7, 8**	**C**	**S**
Fragrant Sumac	*R. aromatica*	**10**	**R**	**S**
Poison Ivy	*R. radicans*	**1, 2, 11**	**C**	**S**
Poison Oak	*R. toxicodendron*	**10**	**U**	**S**
Mountain Winterberry ("Holly")	*Ilex montana*	**5, 10, 11**	**C**	**S** or **T**
Common Winterberry	*I. verticillata*	**6**	**C**	**S**
Mountain Maple	*Acer spicatum*	**5, 11**	**U**	**S** or **T**
Striped Maple	*A. pensylvanicum*	**5, 11**	**C**	**T**
Sugar Maple	*A. saccharum*	**2, 3, 5**	**C**	**T**
Red Maple	*A. rubrum*	**1, 4, 6, 7 8, 9, 10**	**C**	**T**
New Jersey Tea	*Ceanothus americanus*	**1, 10**	**C**	**S**
American Basswood	*Tilia americana*	**2, 5**	**C**	**T**
White Basswood	*T. heterophylla*	**2, 5**	**C**	**T**
Shrubby St. John's-wort	*Hypericum spathulatum*	**6**	**U**	**S**
Leatherwood	*Dirca palustris*	**2**	**R**	**S**
Black Tupelo (Blackgum)	*Nyssa sylvatica*	**1, 4**	**C**	**T**
Flowering Dogwood	*Cornus florida*	**1, 2, 8**	**C**	**T**
Roundleaf Dogwood	*C. rugosa*	**5**	**R**	**S**
Red-panicle Dogwood	*C. racemosa*	**8**	**U**	**S**
Alternate-leaf Dogwood	*C. alternifolia*	**2, 5, 8**	**C**	**S** or **T**
Rosebay Rhododendron	*Rhododendron maximum*	**6**	**R**	**S** or **T**
Catawba Rhododendron	*R. catawiense*	**6, 11**	**U**	**S** or **T**
Pinxter-flower	*R. nudiflorum*	**1, 4, 6**	**C**	**S**

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
Early Azalea	*R. roseum*	1, 4, 10	C	S
Minnie-bush	*Menziesia pilosa*	1, 4, 10	C	S
Mountain-laurel	*Kalmia latifolia*	1, 3, 4, 10, 11	C	S or T
Maleberry	*Lyonia ligustrina*	4, 6, 9	U	S
Black Huckleberry	*Gaylussacia baccata*	1, 4, 10	C	S
Tall Deerberry	*Vaccinium stamineum*	1, 4, 10	C	S
Early Low Blueberry	*V. vacillans*	1, 4, 10	C	S
Late Low Blueberry	*V. angustifolium*	1, 4, 10	C	S
Southern Low Blueberry	*V. pallidum*	1, 4, 10	C	S
Common Highbush Blueberry	*V. corymbosum*	1, 6	C	S
Common Persimmon	*Diospyros virginiana*	7, 8	C	T
White Ash	*Fraxinus americana*	2, 11	C	T
Black Ash	*F. nigra*	9	R	T
Royal Paulownia ("Princess-tree")	*Paulownia tomentosa*	7	U	T
Common Buttonbush	***Cephalanthus occidentalis***	6, 9	U	*S
Northern Bush-honeysuckle	***Diervilla lonicera***	10, 11	C	S
Canada Honeysuckle	***Lonicera canadensis***	3, 6	U	S
Japanese Honeysuckle	***L. japonica***	2, 6, 8	C	Vine
Coralberry	***Symphoricarpos orbiculatus***	7, 8	C	S
Blackhaw	***Viburnum prunifolium***	1, 2, 6, 11	C	S or T
Shortstalk Arrowwood	***V. rafinesquianum***	10	U	S
Southern Arrowwood	***V. dentatum***	6	U	S
Northern Arrowwood	***V. recognitum***	6	U	S

*Classed as a tree in F.S. *Check List.*

Common Name	*Scientific Name*	*Habitats*	*Occurrence*	*Form*
Mapleleaf Viburnum	***V. acerifolium***	**1, 2, 3, 11C**		**S**
Common Elderberry	***Sambucus canadensis***	**6, 8, 9, 11C**		**S**
Red-berried Elder	***Sambucus pubens***	**2, 5, 6, 11C**		**S**

Fishes

The following list is taken from *The Trout Fishery in Shenandoah National Park,* by Robert E. Lennon, 1961.

Species	*Distribution*	*Occurrence*
Rainbow Trout	limited	rare
Brook Trout	wide	abundant
Eastern Redbelly Dace	wide	abundant
Rosy Dace	wide	common
River Chub	limited	rare
Common Shiner	limited	rare
Blacknose Dace	wide	abundant
Longnose Dace	wide	abundant
Creek Chub	limited	rare
White Sucker	wide	rare
Northern Hog Sucker	wide	common
Golden Redhorse	limited	rare
Torrent Sucker	limited	abundant
Margined Madtom	limited	rare
American Eel	limited	rare
Rock Bass	limited	rare
Redbreast Sunfish	limited	rare

Species	*Distribution*	*Occurrence*
Smallmouth Bass	limited	rare
Fantail Darter	wide	abundant
Johnny Darter	wide	abundant
Mottled Sculpin	wide	abundant

Reptiles and Amphibians

This list contains all species recorded or surmised to occur in the park. Except for minor changes, it follows a checklist prepared by William L. Witt (Nov. 1971 manuscript). Common and scientific names follow Roger Conant, *A Field Guide to Reptiles and Amphibians of Eastern North America.* Subspecies, except for a few identifiable in the field, are omitted.

Habitat symbols: S streams; **D** dry woods; **H** humid woods; **U** under cover (rocks, logs); **M** meadows; **R** dry, rocky areas; **B** Big Meadows Swamp
Occurrence symbols: C common; **U** uncommon; **R** rare; **T** transient, not known to breed in park; **E** expected. Status for frogs and salamanders refers to breeding season only.
Elevation range symbols: 1 below 2,000 feet; **2** 2,000 to 3,000 feet; **3** above 3,000 feet.
Breeding period symbols: Sp spring; **Su** summer; **F** fall

Species	*Habitat*	*Occurrence*	*Elevation*	*Breeding Period*
Snapping Turtle *Chelydra serpentina*	**S**	**T**	**1-2**	**Sp**
Stinkpot (Musk Turtle) *Sternothaerus odoratus*	**S**	**T**	**1**	**Su**
Spotted Turtle *Clemmys guttata*	**B**	**E**	**1-2-3**	**Sp**
Wood Turtle *Clemmys insculpta*	**H**	**R**	**2**	**Sp**
Box Turtle *Terrapene carolina*	**D, H, M, B**	**U**	**1-2-3**	**Su**
Painted Turtle *Chrysemys picta*	**S**	**T**	**1**	**Sp**
Fence Lizard *Sceloporus undulatus*	**D, R**	**U**	**1-2**	**Su**
Five-lined Skink *Eumeces fasciatus*	**D, H, U, R**	**U**	**1-2**	**Su**
Broad-headed Skink *Eumeces laticeps*	**D, U, R**	**R**	**1-2-3**	**Su**

Species	*Habitat*	*Occurrence*	*Elevation*	*Breeding Period*
Coal Skink *Eumeces anthracinus*	**H, U**	**R**	**1-2**	**Su**
Northern Water Snake *Natrix sipedon*	**S, H, U**	**U**	**1-2**	**Su**
Queen Snake *Natrix septemvittata*	**S, U**	**R**	**1**	**Su**
Brown Snake (DeKay's Snake) *Storeria dekayi*	**D, H, U, M, B**	**E**	**1-2-3**	**Su**
Red-bellied Snake *Storeria occipitomaculata*	**D, H, U, M, B**	**U**	**1-2-3**	**Su**
Eastern Garter Snake *Thamnophis sirtalis*	**S, D, H, U, M, R, B**	**U**	**1-2-3**	**Su**
Ribbon Snake *Thamnophis sauritus*	**S, H, U, M**	**U**	**1-2**	**Su**
Smooth Earth Snake *Haldea valeriae*	**D, H, U, M**	**E**	**1-2**	**Su**
Eastern Hognose Snake *Heterodon platyrhinos*	**D, H, M**	**U**	**1-2**	**Su**
Ringneck Snake *Diadophis punctatus*	**D, H, U, M, R, B**	**C**	**1-2-3**	**Su**
Worm Snake *Carphophis amoenus*	**H, U, M**	**U**	**1-2-3**	**Su**
Black Racer *Coluber constrictor*	**D, H, U, M, R, B**	**U**	**1-2-3**	**Su**
Rough Green Snake *Opheodrys aestivus*	**M**	**U**	**1-2**	**Su**
Smooth Green Snake *Opheodrys vernalis*	**U, M**	**U**	**2-3**	**Su**
Corn Snake *Elaphe guttata*	**H, U, M**	**R**	**1-2**	**Su**
Black Rat Snake *Elaphe obsoleta*	**H, U, M, R**	**U**	**1-2**	**Su**
Pine Snake *Pituophis melanoleucus*	**D, R**	**R**	**2-3**	
Eastern Kingsnake *Lampropeltis getulus*	**H, U**	**R**	**1-2**	**Su**
Milk Snake *Lampropeltis doliata*	**D, H, U, M, B**	**U**	**1-2-3**	**Su**
Mole Snake *Lampropeltis calligaster*	**H, U**	**E**	**1**	**Su**
Scarlet Snake *Cemophora coccinea*	**H, U**	**E**	**1-2-3**	**Su**
Crowned Snake *Tantilla coronata*	**D, U, M**	**E**	**1-2**	**Su**
Copperhead *Agkistrodon contortrix*	**D, H, U, M, R**	**U**	**1-2-3**	**F**
Timber Rattlesnake *Crotalus horridus*	**D, H, U, R**	**U**	**1-2-3**	**F**

Species	*Habitats*	*Occurrence*	*Elevation*	*Breeding Period*
Jefferson Salamander *Ambystoma jeffersonianum*	**M, B**	**R**	**3**	**Sp**
Marbled Salamander *Ambystoma opacum*	**M**	**E**	**1**	**F**
Spotted Salamander *Ambystoma maculatum*	**M, B**	**U**	**1-2-3**	**Sp**
Red-spotted Newt *Diemictylus viridescens*	**S, D, H, U**	**U**	**1-2-3**	**Sp**
Dusky Salamander *Desmognathus fuscus*	**S, U, B**	**C**	**1-2-3**	**Sp, Su**
Allegheny Mountain Salamander *Desmognathus ochrophaeus*	**S, H ,U, B**	**E**	**2-3**	**Sp, Su**
Virginia Seal Salamander *Desmognathus monticola jeffersoni*	**S, U, B**	**C**	**1-2-3**	**Sp, Su**
Red-backed Salamander *Plethodon cinereus*	**H, U**	**C**	**1-2-3**	**Sp, Su**
Shenandoah Salamander *Plethodon richmondi shenandoah*	**D**	**U**	**3**	**Sp, Su**
Slimy Salamander *Plethodon glutinosus*	**D, H, U, R**	**C**	**1-2-3**	**Sp, Su**
Four-toed Salamander *Hemidactylium scutatum*	**B**	**C**	**1-2-3**	**Sp**
Spring Salamander *Gyrinophilus porphyriticus*	**S, U, B**	**U**	**1-2-3**	**Sp**
Northern Red Salamander *Pseudotriton ruber ruber*	**S, H, U**	**R**	**1-2**	**F**
Blue Ridge Red Salamander *Pseudotriton ruber nitidus*	**S, H, U**	**R**	**1**	**F**
Two-lined Salamander *Eurycea bislineata*	**S, H, U, B**	**C**	**1-2-3**	**F**
Long-tailed Salamander *Eurycea longicauda longicauda*	**S, H, U**	**R**	**1-2-3**	**F**
Three-lined Salamander *Eurycea longicauda guttolineata*	**S, H, U**	**E**	**1**	**F**
Eastern Spadefoot *Scaphiopus holbrooki*	**H, M**	**R**	**1**	**Su**
American Toad *Bufo americanus*	**D, H, M, R, B**	**C**	**1-2-3**	**Sp**
Fowler's Toad *Bufo woodhousei*	**D, H, M, R, B**	**U**	**1-2**	**Sp**
Northern Cricket Frog *Acris crepitans*	**S, H**	**U**	**1-2**	**Sp**
Spring Peeper *Hyla crucifer*	**S, H, B**	**U**	**1-2-3**	**Sp**
Gray Treefrog *Hyla versicolor*	**S, H, B**	**U**	**1-2-3**	**Sp**
Upland Chorus Frog *Pseudacris triseriata*	**S, H, B**	**U**	**1-2-3**	**Sp**

Species	*Habitats*	*Occurrence*	*Elevation*	*Breeding Period*
Mountain Chorus Frog *Pseudacris brachyphona*	**S**	**E**	**1**	**Sp**
Bullfrog *Rana catesbeiana*	**S, B**	**R**	**1-2-3**	**Sp**
Green Frog *Rana clamitans*	**S, B**	**C**	**1-2-3**	**Sp**
Leopard Frog *Rana pipiens*	**S**	**E**	**1**	**Sp**
Pickerel Frog *Rana palustris*	**S, B**	**C**	**1-2-3**	**Sp**
Wood Frog *Rana sylvatica*	**S, D, H, U, M, B**	**U**	**1-2-3**	**Sp**

Birds

The following list contains all species reliably reported within or flying over the park, as of November, 1971. With minor changes, the list and the status of each species follows the checklist compiled by Dr. E. J. Wilhelm, Jr., June, 1966. Charles E. Stevens provided the habitat data. Common names follow the A.O.U. *Check-list of North American Birds,* 5th Edition, 1957. Where no habitat symbol appears, either the species is generally seen flying, it is rare, or its habitat use within the park has not been determined.

Habitat symbols: **1** oak, oak-hickory forest; **2** cove hardwoods; **3** hemlock, hemlock-white pine groves; **4** oak-pine forest; **5** birch-maple forest; **6** wooded streams, stream margins, boggy places; **7** fields, road shoulders; **8** shrubby abandoned fields; **9** shrub swamp; **10** open cliffs, rock outcrops; **11** shaded cliffs, rock outcrops.

Occurrence symbols: **A** accidental, unexpected because extra-limital, only one park record; **O** occasional, two to eight park records; **R** rare, occurs at wide intervals, usually in small numbers; **U** uncommon, occurs in small numbers in limited habitats; **C** common, occurs regularly in suitable habitats
Seasonal symbols: **Sp** spring; **Su** summer; **F** fall; **W** winter
Status symbols: **r** resident, present throughout year, breeds in park; **b** breeder, breeds in park in summer, spends cooler months south; **t** transient, passes through park in migration, non-breeder; **v** visitor, wanders into park in summer or winter, non-breeder.

Species	*Habitats*	*Occurrence*
Horned Grebe		**A**
Pied-billed Grebe		**O**
Great Blue Heron		**O, Su, v**

Species	*Habitats*	*Occurrence*
Green Heron		**U, Su, v**
Common Egret		**A**
American Bittern		**A**
Canada Goose		**U, t**
Mallard	**6**	**O, t**
Black Duck		**O, W, v**
Blue-winged Teal		**O, t**
Wood Duck	**6**	**U, b**
Canvasback		**A**
Turkey Vulture		**C, r**
Black Vulture		**U, r**
Goshawk		**O, W, v**
Sharp-shinned Hawk		**C, t** **U, W, v**
Cooper's Hawk		**U, r**
Red-tailed Hawk		**C, r**
Red-shouldered Hawk		**U, r**
Broad-winged Hawk		**C, b** **C, t**
Rough-legged Hawk		**U, t** **U, W, v**
Golden Eagle		**R, t** **R, W, v**
Bald Eagle		**R, t** **R, W, v**
Marsh Hawk		**U, t** **U, W, v**
Osprey		**U, t** **U, Su, v**
Peregrine Falcon		**R, t**
Pigeon Hawk		**U, t**

Species	*Habitats*	*Occurrence*
Sparrow Hawk		**U, t** **O, b**
Ruffed Grouse	**1-11**	**C, r**
Bobwhite	**7, 8**	**C, r**
Ring-necked Pheasant		**O, r**
Turkey	**1-11**	**U, r**
Killdeer		**O, t** **O, Su, v**
American Woodcock	**6-9**	**C, b**
Common Snipe		**O, t**
Upland Plover		**O, t**
Spotted Sandpiper		**O, t**
Solitary Sandpiper		**O, t**
Dunlin		**A**
Herring Gull		**O, t**
Mourning Dove	**4, 7, 8**	**C, r**
Yellow-billed Cuckoo	**1, 2**	**C, b**
Black-billed Cuckoo	**1, 2**	**C, b**
Barn Owl		**R, r**
Screech Owl	**1-11**	**U, r**
Great Horned Owl	**1-11**	**U, r**
Barred Owl	**1-11**	**C, r**
Long-eared Owl		**O, W, v** **O, t**
Saw-whet Owl		**O, W, v** **O, t**
Whip-poor-will	**1-11**	**C, b**
Common Nighthawk	**1-11**	**C, t**

Species	*Habitats*	*Occurrence*
Chimney Swift		**U, b** **C, Su, v**
Ruby-throated Hummingbird	**1-11**	**C, b**
Belted Kingfisher	**6**	**U, r**
Yellow-shafted Flicker	**1-11**	**C, r**
Pileated Woodpecker	**1, 2, 3, 5**	**C, r**
Red-bellied Woodpecker	**1, 2**	**C, r**
Red-headed Woodpecker		**U, r**
Yellow-bellied Sapsucker	**1, 2, 3, 5**	**C, t** **U, W, v**
Hairy Woodpecker	**1, 2, 3, 5**	**C, r**
Downy Woodpecker	**1-11**	**C, r**
Eastern Kingbird	**7, 8**	**U, b**
Great Crested Flycatcher	**1, 2, 3**	**C, b**
Eastern Phoebe	**1-11**	**C, b**
Yellow-bellied Flycatcher	**1, 2, 3**	**U, F, t**
Acadian Flycatcher	**2, 3**	**U, b**
Traill's Flycatcher	**8, 9**	**O, t**
Least Flycatcher	**1-11**	**O, t** **U, b?**
Eastern Wood Pewee	**1, 2, 3, 5**	**C, b**
Olive-sided Flycatcher	**8**	**O, t**
Horned Lark	**7**	**U, t** **O, W, v** **O, b**
Tree Swallow		**O, t**
Bank Swallow		**O, t**
Rough-winged Swallow		**O, b** **U, Su, V**

Species	*Habitats*	*Occurrence*
Barn Swallow		**U, b** **C, Su, v C, t**
Cliff Swallow		**O, t** **O, Su, v**
Purple Martin		**O, t** **O, Su, v**
Blue Jay	**1-11**	**C, r** **C, t**
Common Raven	**1-11**	**C, r**
Common Crow	**1-11**	**C, r**
Fish Crow	**1-11**	**O, t** **O, Su, v**
Black-capped Chickadee	**1-6, 8-11**	**W, v**
Carolina Chickadee	**1-6, 8-11**	**C, r**
Tufted Titmouse	**1-6, 8-11**	**C, r**
White-breasted Nuthatch	**1-5**	**C, r**
Red-breasted Nuthatch	**3, 4**	**U, t** **U, W, v**
Brown Creeper	**1-5**	**C, t** **C, W, v**
House Wren	**8**	**C, b**
Winter Wren	**1, 2, 3, 5**	**U, t** **U, W, v** **U, b**
Bewick's Wren	**8**	**U, b**
Carolina Wren	**1, 2, 3, 6, 10, 11**	**C, b**
Mockingbird	**7, 8**	**U, r**
Catbird	**4, 8, 9**	**C, b**
Brown Thrasher	**4, 8**	**C, b**
Robin	**7, 8**	**C, b** **C, t** **U, W, v**
Wood Thrush	**1, 2, 3, 5**	**C, b**
Hermit Thrush	**1-5**	**C, t** **U, W, v**

Species	*Habitats*	*Occurrence*
Swainson's Thrush	1, 2, 3, 5	C, t
Gray-cheeked Thrush	1, 2, 3, 5	C, t
Veery	3, 5, 9, 11	C, b
Eastern Bluebird	7, 8	U, b C, W, v
Blue-gray Gnatcatcher	1, 2	U, b U, t
Golden-crowned Kinglet	1-5	C, t U, W, v
Ruby-crowned Kinglet	1-5, 8	C, t O, W, v
Water Pipit	7	O, t
Cedar Waxwing	1-9	C, b C, F, t O, W, v
Loggerhead Shrike	7	O
Starling	7	C, r
White-eyed Vireo	6, 8	U, b
Yellow-throated Vireo	1, 2, 3	U, b C, t
Solitary Vireo	1, 2, 3, 5	C, b C, t
Red-eyed Vireo	1, 2, 3, 5	C, b C, t
Philadelphia Vireo	1, 2	O, t
Warbling Vireo	6	O, b O, t
Black and White Warbler	1, 2, 3, 5	C, b C, t
Worm-eating Warbler	1, 2	U, b O, t
Golden-winged Warbler	8	U, t R, b
Blue-winged Warbler	8	U, t R, b
Tennessee Warbler	1-5, 8	C, t
Orange-crowned Warbler	8	U, t
Nashville Warbler	1-5, 8	U, Sp, t C, F, t

Species	*Habitats*	*Occurrence*
Parula Warbler	**2, 3, 6**	**C, b** **C, t**
Yellow Warbler	**8**	**O, t**
Magnolia Warbler	**1-6, 9**	**U, Sp, t** **C, F, t**
Cap May Warbler	**1-5**	**U, Sp, t** **C, F, t**
Black-throated Blue Warbler	**2, 3, 5**	**C, b** **C, t**
Myrtle Warbler	**1-11**	**C, t** **U, W, v**
Black-throated Green Warbler	**1, 2, 3, 5**	**U, b** **C, t**
Cerulean Warbler	**1, 2**	**U, t** **U, b**
Blackburnian Warbler	**2, 3**	**C, b** **C, t**
Yellow-throated Warbler	**6**	**O, b** **U, t**
Chestnut-sided Warbler	**4, 5, 8, 9**	**C, b** **C, t**
Bay-breasted Warbler	**1, 2, 3, 5**	**C, t**
Blackpoll Warbler	**1, 2, 3, 5**	
Pine Warbler	**4**	**U, b**
Prairie Warbler	**4, 8**	**C, b**
Palm Warbler	**7, 8**	**U, t**
Ovenbird	**1-5**	**C, b** **C, t**
Northern Waterthrush	**6, 9**	**O, t**
Louisiana Waterthrush	**6**	**C, b**
Kentucky Warbler	**2, 6**	**U, b**
Connecticut Warbler	**8**	**O, F, t**
Yellowthroat	**8, 9**	**C, b**
Yellow-breasted Chat	**8**	**C, b**
Hooded Warbler	**1, 2**	**C, b**
Wilson's Warbler	**8, 9**	**U, t**
Canada Warbler	**3, 5, 11**	**C, b** **C, t**
American Redstart	**2, 6**	**C, b** **C, t**

Species	*Habitats*	*Occurrence*
House Sparrow	**(around buildings)**	**U, r**
Bobolink		**O, t**
Eastern Meadowlark	**7**	**U, b** **U, t** **U, W, v**
Red-winged Blackbird		**O, Sp, Su**
Orchard Oriole		**U, b**
Baltimore Oriole	**1, 2**	**U, t** **U, b**
Rusty Blackbird	**9**	**O, t**
Common Grackle	**1-9**	**C, t** **U, b**
Brown-headed Cowbird	**1-9**	**C, b**
Scarlet Tanager	**1, 2, 3, 5**	**C, b** **C, t**
Summer Tanager	**1**	**O, t**
Cardinal	**8**	**C, r**
Rose-breasted Grosbeak	**1, 2, 3, 5**	**C, b** **C, t**
Evening Grosbeak	**1, 2, 3**	**C, t** **C, W, v**
Blue Grosbeak	**8**	**U, b** **U, t**
Indigo Bunting	**7, 8, 10**	**C, b** **C, t**
Painted Bunting		**A**
Purple Finch	**1-11**	**C, t** **O, W, v**
Pine Grosbeak	**5, 8**	**O, W, v**
Pine Siskin	**3, 4, 5**	**C, t** **C, W, v**
American Goldfinch	**1-11**	**C, r**
Red Crossbill	**4**	**U, t** **U, W, v**
White winged Crossbill	**3**	**O, W, v**
Rufous-sided Towhee	**4, 5, 8,**	**C, b**
Savannah Sparrow	**7**	**U, t**
Grasshopper Sparrow	**7**	**O, Su, v**
Henslow's Sparrow	**7**	**O, b**
Vesper Sparrow	**7**	**C, b**

Species	*Habitats*	*Occurrence*
Bachman's Sparrow	**8**	**O, Su,v**
Slate-colored Junco	**1, 2, 3, 5, 11**	**C, t** **C, r**
Tree Sparrow	**8**	**C, W, v** **C, t**
Chipping Sparrow	**7, 8**	**C, b** **C, t**
Field Sparrow	**8**	**C, b** **C, t** **U, W, v**
White-crowned Sparrow	**8**	**C, t** **U, W, v**
White-throated Sparrow	**3, 8**	**C, t** **U, W, v**
Fox Sparrow	**4, 8**	**C, t** **U, W, v**
Lincoln's Sparrow	**8, 9**	**O, t**
Swamp Sparrow	**8, 9**	**C, t**
Song Sparrow	**8, 9**	**U, r** **C, t**
Lapland Longspur	**7**	**O, t**
Snow Bunting	**7**	**O, t** **O, W, v**

Mammals

This list contains all mammals recorded in the park, and 10 species (in brackets) which occur in adjacent areas and may be expected to occur in the park. It is based primarily on Dr. Richard H. Manville's *The Mammals of Shenandoah National Park,* 1956.

Distribution by elevation, which roughly indicates climatic tolerances of a species or distribution of suitable habitat, is given where known.

Occurrence symbols (where known): **C** common; **U** uncommon; **R** rare. The more secretive species and those difficult to identify in the field, such as bats, may be more common than indicated.

Elevation range symbols: 1 below 2,000 feet; **2** 2,000 to 3,000 feet; **3** above 3,000 feet. Most of these animals inhabit either forest or a variety of habitats.

Common names follow Burt and Grossenheider's **A Field Guide to the Mammals.**

Common Name	*Occurrence Form*	*Elevation*
Virginia Opossum	**C(1)** **U(2-3)**	**1-2-3**
[Hairytail Mole]		
Eastern Mole	**C**	**1-2-3**

Common Name	*Occurrence Form*	*Elevation*
[Starnose Mole]		
Masked Shrew	**C?**	
Smoky Shrew	**U**	**2-3**
[Southeastern Shrew]		
[Pigmy Shrew]		
Least Shrew	**R?** (park hdqs.)	**1?**
Shorttail Shrew	**C**	**1-2-3**
Little Brown Myotis (Little Brown Bat)	**C**	
Keen Myotis	**U**	
[Indiana Myotis]		
[Small-footed Myotis]		
[Silver-haired Bat]		
Eastern Pipistrel	**U**	
Big Brown Bat	**C**	**1-2-3**
Red Bat	**U**	**1-2-3**
[Hoary Bat]		
Black Bear	**U**	**1-2-3**
Raccoon	**C**	**1-2-3**
Fisher (formerly)		
[Least Weasel]		
Longtail Weasel	**U**	**1-2-3**
Mink	**U**	**1** (streams)
River Otter	(one record, in 1890's)	
Spotted Skunk	**U**	**1-2-3**

Common Name	*Occurrence Form*	*Elevation*
Striped Skunk	**C**	**1-2-3**
Red Fox	**U**	**1-2**
Gray Fox	**C**	**1-2-3**
Gray Wolf (formerly)		
Mountain Lion (Cougar)	(current status unknown)	
Bobcat	**C**	**1-2-3**
Woodchuck	**C**	**1-2-3**
Eastern Chipmunk	**C(2-3)** **U(1)**	**1-2-3**
Red Squirrel	**U**	**1-2-3**
Gray Squirrel	**C**	**1-2-3**
Fox Squirrel	**R**	
Southern Flying Squirrel	**C**	**1-2-3**
Beaver	**R**	**1** (streams)
Eastern Harvest Mouse	(one record)	
Deer Mouse	**C**	**2-3**
White-footed Mouse	**C**	**1-2-3**
Northeastern Woodrat	**U?**	**1-2-3**
[Southern Bog Lemming]		
Boreal Redback Vole	**C**	**2-3**
Meadow Vole	**C**	**1-2-3** (openings)
Pine Vole	**U**	**1?-2-3**
Muskrat	**U**	**1** (streams)
Black Rat	**U**	**1-2-3** (buildings)
Norway Rat	**U?**	(buildings)

Common Name	*Occurrence*	*Elevation*
House Mouse	**U?**	**1-2-3** (buildings and old homesites)
Meadow Jumping Mouse	**C?**	**1-2-3** (openings)
Woodland Jumping Mouse	(one record)	
Eastern Cottontail	**C**	**1-2-3**
New England Cottontail	(one record)	
Elk (formerly)		
Whitetail Deer	**C**	**1-2-3**
Bison (formerly)		

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All drawings by Anne Lacey.

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Napier Shelton, a lifelong resident of Washington, D.C., is a dedicated naturalist with a special interest in ornithology. He holds an M.A. in plant ecology from Duke University and a Ph.D. in geography from the University of Michigan.